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SELECTED ECONOMIC TRANSLATIONS ON EASTERN EUROPE

(159th in the series)

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SELECTED ECONOMIC TRANSLATIONS ON EASTERN EUROPE

INTRODUCTION

This is a serial publication containing selected translations on all categories of economic subjects and on geography. This report contains translations on subjects listed in the table of contents below. The translations are arranged alphabetically by country.

TABLE OF CONTENTS

EAST GERMANY

The Development of the Chemical Industry-- Review and Preview

[This is a translation of an article by Walter Singer in Chemische Technik, No 9, September 1959, Berlin, pages 467-470; CSO: 3276-N/1]

Ten years is historically a short time, especially in the chemical industry, where, as is well known, new developments always take a relatively long time.

On the other hand, a tremendous amount can be done in ten years if the technical, scientific, and production development is freed of the inhibitions of the capitalist profit drive and is furthered by the enthousiastic devotion of the workers, as has been the case in our chemical industry since the establishment of the German Democratic Republic.

We now stand at the outset of the first German chemistry program, which is the largest undertaking [to date] of the chemical industry, and note that we are in a very favorable position to start such an undertaking. We should remember how the situation was 10 years ago and review what has been accomplished during these past ten years through the combined efforts of all the employees of the chemical industry.

The level of the sulfuric acid production is often taken throughout the world as a criterion of the level of the chemical industry. Let us thus examine the development curve [of sulfuric acid production] in the GDR from 1949 until today and the planned development until 1965 (Figure 1). This examination does not need any further explanation.

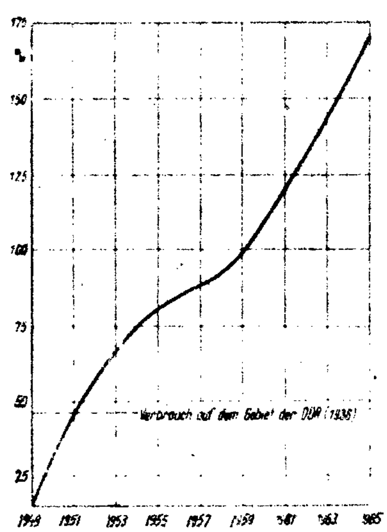


Figure 1

Development of Sulfuric Acid Production, 1949-1965

----GDR consumption 1936

Today the efforts in the sulfuric acid factories no longer center around the many small concerns and make-shifts of former years. Today, for example, we produce the cheapest sulfuric acid in the world in the leading sulfuric acid plant in Wolfen and have attained the highest specific apparatus yield. In a few years, in Coswig, we will have the largest and at the same time the most modern sulfuric acid plant in the world. The plant will have a capacity of 300,000 tons of SO_3 and will also operate with domestic raw materials. In the existing sulfuric acid plants, hard physical labor is gradually being replaced with increased mechanization and automation of the individual production processes.

The production of soda, which is an important base substance not only for many chemical products--including washing powders--but also for the glass industry, is also generally considered a criterion of the state of economic development. Figure 2 shows the increased production made possible by the building of new units in Stassfurt and Bernburg during the last ten years. Since the demand is also satisfied for the near future, the further development will lie in improving the quality and further reducing the costs.

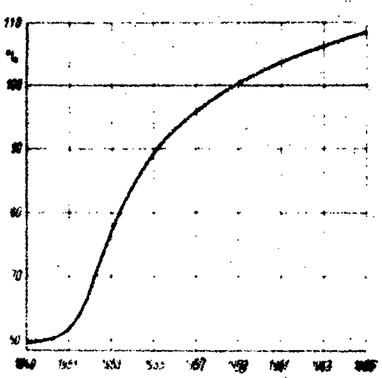


Figure 2

Development of Soda Production, 1949 to 1965

In contrast to the situation of former years, the amount of chlorine produced is of decisive importance for the rapid develop of organic chemical production--for example, for solvents and plastics. While up to now the demand for sodium hydroxide has determined the amount of chlorine available--and chlorine had to be destroyed for many years--the demand for chlorine production has now become and will continue to be the determining factor. Thus, in perspective, chlorine production processes which yield not sodium hydroxide but another valuable product will gain in importance. The current development projects will make it possible to put such procedures into operation already within the next few years. Until then, the necessary production increase will be carried out through new buildings, using newly de eloped electrolysis cells with a load fo 50,000 amperes, as well as through the intensification of existing electrolysis installations--

for example, by the incorporation of fluted or comb cathode baths. With the planned increase in the production of chlorine up to 1965, the organic chemical industry will have a good basis for development.

Even though the development concentrated at first on assuring the production of the decisive inorganic basic chemicals, the production of basic organic chemical was not neglected.

A basis for this branch of the chemical industry, and so far the only basis for the production of synthetic rubber and thermoplastics, was the production of calcium carbide. This production also formed the decisive basis for the production of basic aliphatic chemicals. The production of calcium carbide, however, was less a technical problem of the chemical industry than a problem of electric power production. If today we consider with pride the development of the carbide production over the past ten years, the credit is due to a large extent to our colleagues in two other branches of the industry: those of power production and power machine-building, whose great achievements made this progress possible.

In the chemical industry proper, the development led to carbide oven units with higher yields, which at present are characterized by a power intake of 40,000 kilowatts per oven unit.

Figure 3 indicates that the carbide production will further increase sharply in the future, within the framework of the chemistry program. For this purpose, new carbide ovens are being erected in Buna and Piesteritz and at the same time the existing ovens are being rebuilt along the lines of the most modern technical developments. The capacity of all installed carbide ovens will considerably exceed the planned carbide production. This fact is especially noteworthy. In this manner the carbide factories can be used for the so-called "dark regulation" of the power network, in that the load on the ovens can be widely varied to coordinate with the varying demands of the rest of the economy; specifically, they can be used for maximal current use during the night.

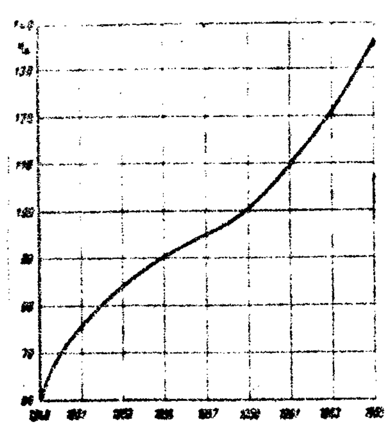


Figure 3

Development of Calcium Carbide Production--1949-1965

With these developments, the VEB Buna Chemical Plant will be not only the largest carbide factory in the world but will also be in the lead as far as the technology of the carbide production is concerned.

Every specialist will be aware of the possibilities of organic chemical production associated with this tremendous carbide basis; thus the production of synthetic rubber will be considerably increased, with emphasis on the new types of rubber, such as Buna S4T, and the use of such new procedures as low-temperature polymerization. The greatest development will take place in thermoplastics, especially those made on the basis of vinyl compounds. An especially typical example of this is shown in Figure 4. This figures gives the actual or planned production development of PVC from 1949 to 1965. The great development of PVC is characteristic of the rapid development of all thermoplastics. Even now t e GDR produces the cheapest PVC in the world, in unsurpassed good quality. In 1965 the GDR will be among the largest producers of PVC in the world.

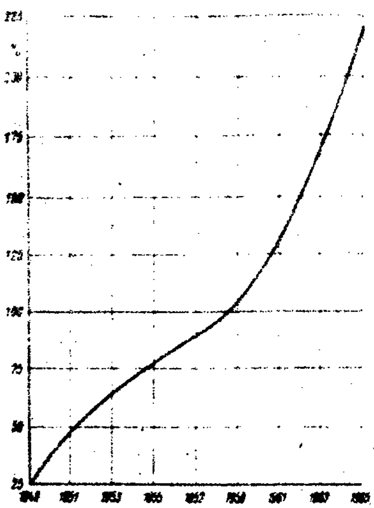


Figure 4

Development of PVC [polyvinylchloride] Production, 1949 to 1965

In 1949, lignite chemistry--another basis for organic chemistry production--after the worst of the war damage had been repaired, was in a relatively favorable starting position. It was thus possible to realize, in the existing plants, the necessary increase in the production of--for example--fuels, by mobilizing the inner reserve capacities, by technical-scientific improvements, and by raw material changes, such as from tar to petroleum. In this connection the tremendous achievement of the workers in the lignite pits who, without tiring and under the most difficult conditions, made the production of the chemical industry possible must be remembered.

Increasing quantities of petroleum have been used over the past few years as another raw material for the organic chemistry industry. However, the proportion of petroleum to lignite was relatively low and reached about 38 percent in 1959. In 1965, however, the proportion of petroleum will

make up 76 percent of the total 8 million tons of hydrocarbons raw materials used, and will thus create the prerequisites for a modern petrochemistry in the GDR. We will than have not only such new raw materials as the olefins--in particular ethylene--but also the most important aromatic substances, such as benzine and toluene, and particularly the xylenes. These substances previously had to be imported, since, as is known, the GDR does not have large anthracite deposits.

The center for the development of petrochemistry will be in the Halle-Leuna region until 1965. Ethylene, for example, is produced in Leuna, by cracking light petroleum fractions. This is done by procedures which also yield a high proportion of aromatic substances. This quantity of ethylene makes it possible to build plants with a capacity of several 10,000 tons for the manufacture of polyethylene, by both high-pressure and low-pressure methods. At the same time, a considerable quantity of acetylene will become available. The latter previously had to be used for the manufacture of ethylene by hydrogenation, as in the production of ethyl-benzine, styrene, ethylene oxide, and other products.

It is of very great significance for the development of the chemical industry of the GDR that benzine, which was a typical product of anthracite chemistry, will also be available in the future in great quantities on a petrochemical basis. Mixtures containing aromatic substances of the most varied origins are processed for this purpose, such as condensates from ethylene cokers, natural gas cracking units, platformers, etc.

The domestic production of great quantities of benzine makes it possible to build a plant in Leuna for the manufacture of synthetic phenol according to the cumene procedure (see Figure 5). This in turn leads to an increase in the caprolactam production for dederon production in such plants as the Guben Chemical Fiber Combine.

The xylenes, especially o-xylene, are available in such a large quantity as products of petrochemistry in Boehlen and Schwedt that they not only assure the supply of DMT [not identified]

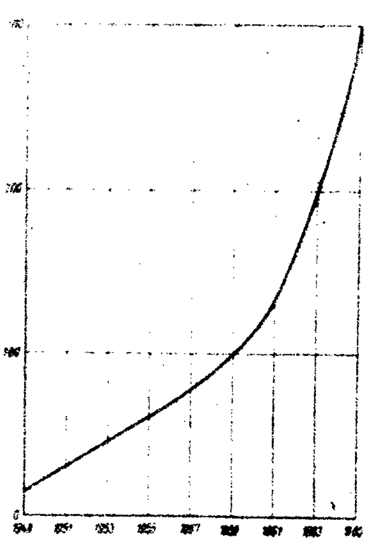


Figure 5

Production of Pure Phenol, 1949-1965

for lanon fiber production in the Guben Chemical Fiber Combine but also to a large extent satisfy the increasing demand for phthalic acid, especially for plasticizers. For this purpose a plant for the production of phthalic acid from o-xylene is also being built in Buna.

Aside from the development of petrochemistry in the Halle-Leuna region up to 1965, a new center for fuel production is being created by the building of the Schwedt Petroleum Combine. This center will also serve as a basis for the rapid development of petrochemical production after 1965. By 1965, 4 million tons of Soviet petroleum will be processed in Schwedt. The oil is brought to the plant by pipeline and processed. A technically simple distillation procedure is planned for the near future. The technical development of the plant will be up to the most modern technical standards and will permit a productivity 12 times as high as that of existing fuel plants. Until 1965 Schwedt will be primarily a fuel production plant, concerned with the adequate supply of fuel and will contribute especially to the heating oil supply. It will, however, contribute aromatic substances for the chemical industry from 1963 on. Within the framework of the development of petrochemistry, as a basis for organic chemical production, the production of fuels can no longer be separated from the production of petrochemical products. This is illustrated, for exampl1e, in the platforming procedure, which was developed originally to improve the properties of carburetor fuels and which now provides at the same time the raw materials for the production of aromatic substances.

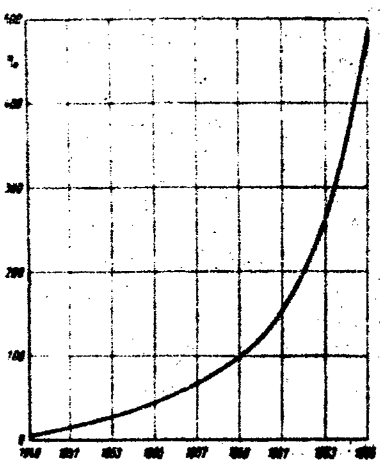


Figure 6

Production of Synthetic Fibers, 1949-1965

As in the case of plastics, the manufacture of chemical fibers can only proceed when the production of basic chemicals is adequately developed. The production of regenerated fibers, such as cellulose, could thus really develop only with an increase in the production of inorganic basic chemicals, such as sulfuric acid and sodium hydroxide. This is clearly expressed in the increase from about 40,000 tons in 1949 to almost 150,000 tons in 1959. The production of synthetic fibers like dederon developed almost explosively. A trial production of about 300 tons was made in 1950 and 8,000 tons is being produced in 1959 (see Figure 6). The Seven-Year Plan provides for a further

large development. Aside from the further development of the production of PC, the oldest synthetic fiber, the production of polyacrylonitrile fibers and dederon silks is to be expanded further, and the production of lanon fibers and lanon silk is to be put into operation. The central point for these developments is the new Guben Chemical Fiber Combine. By means of the most modern technical equipment, the work productivity will be three times as great as at present. By 1965 the volume of synthetic fibers produced in the GDR will be five times as high as in 1959. Three quarters of this will consist of wool type fibers. In this manner the quality of our textiles is being considerably improved with the help of chemistry.

Paints and lacquers are of great significance for the total economy, not only as protectors against corrosion but also for esthetic purposes. In 1949 the production of lacquers and paints was less than 50,000 tons. It was insufficient, from the point of view of both quantity and quality. Furthermore, all important raw materials had to be imported. That the production multiplied two and one-half time during the past years, and that only 0.05 percent of the total production has to be imported indicates the considerable development that took place in this branch of specialized chemical production. The production of lacquers and paints is to increase further to about 280,000 tons by 1965. At the same time, the approximately 5,000 different types are to be reduced to 1,500, and the production is to be concentrated in fewer than 40 plants. By means of the above measures, but also by the modernization of the technical equipment, the work productivity can be increased threefold. Of special significance is the planned quality improvement. In this manner the world standard will be reached within the next few years for all important products of this production branch.

A very diversified branch of chemical production is the industrial branch for rubber products, which manufactures not only tires for motor vehicles, conveyor belts, etc. but also an infinite variety of about 25,000 different technical rubber products. Taking into consideration the diversity of the production and its importance to almost all parts of the economy, the production increase of the past ten years, which amounted to an increase of 300 to 400 percent in almost all production groups, is an especially great achievement. If we now consider the goals of the Seven-Year Plan in this industrial branch, we note that they concern especially--aside from a further considerable production increase of 230 percent in

the production of tires for motor vehicles alone and a multiplication of the present production output for many products of the rubber industry--a planned improvement in the quality of the products and a far-reaching mechanization of the production plants. Thus, for instance, the durability of tires for motor vehicles is to be increased by at least 50 percent, the dosage and mixing of the initial materials is to be mechanized in the manufacturing process, and assembly line production methods are to be introduced into the production of finished products by means of special machinery.

An especially difficult situation existed in pharmaceuticals in 1949. All large pharmaceutical producers, especially those manufacturing pharmaceutical bases, were located in West Germany; only a few proeucers of galenic products and mixed pharmaceuticals were located in the territory of the GDR. The fact that today we can supply 95 percent of the needed pharmaceuticals from domestic production indicates a tremendous technical and scientific achievement which was accomplished without fanfare, and of which the public has noted little more than a steadily improving supply. Thus today all significant antibiotics, such as penicillin, streptomycin, oxytetracyclin, etc. and a large assortment of modern sulfonamides are part of the regular production. In some instances this has been so for many years. To cite a few other examples, the same is true of pyrazolones, salicylates, and purine derivatives, as well as the most diversified vitamins and hormones. The most important glucosides and alkaloids are now available is sufficient quantities. One can say today that practically all drugs needed for the practice of modern therapy are produced domestically.

Perhaps this development from nothing to the actual high standard of our pharmaceutical production is best illustrated by the fact that the pharmaceutical preparations of the GDR are already exported to many countries and have won a reputation and confidence.[1] This excellent development will now be continued within the framework of the chemistry program. The production and the work productivity will increase by 200 percent. A continuous expansion of the assortment of drugs available, a definite improvement in the packaging, and a greater variety of forms in which drugs are available, as well as extensive changes in the specialization and concentration of the production and modernization of the manufacturing plants will be among the important changes made in the pharmaceutical industry.

On the basis of preferential development of basic chemicals, it was also possible to develop over the past ten years a group of chemical speciality products which, as consumer goods, directly demonstrate the success of the chemical industry to all employees. Who still remembers the kaolin soap that was obtainable on ration coupons in 1949 when today one can buy any type of toilet soap one desires? It is a simple example, but it perhaps best demonstrates the tremendous development of the chemical industry in the GDR. It was necessary to build up the fatty acid synthesis by paraffin oxidation and create a capacity for the separation of fats and fatty alcohols, etc. Let us not forget the many other products of chemistry which determine the appearance and odor of chemical consumer goods. We note as a result of the work of the last ten years that the demandfor all important products of this type, such as washing powders, soaps, cosmetic and household chemical products is adequately covered by an assortment of products. The main task over the next few years is to improve the quality of the products, especially from the point of view of appearance, in such a manner that they correspond from all points of view to the very high world standard. For this, new facilities for the production of high-quality primary substances, such as fatty alcohols and alkylarylsulfonates will be created, and the technology of the various production processes of the final products will be improved.

At the same time there will be a specialization and concentration of the production in this field, which is still scattered from former years. An orientation of the production to fewer products of the highest quality will take place, with due consideration to the fact that it is necessary to have many different products.

It was not the aim of this survey to treat extensively all the problems of the development of the chemical industry, but it is good to review, especially at the beginning of a new period which plans further development by the largest and most inclusive program, the situation as it existed in the years of the founding of the German Democratic Republic, and to consider the steep climb as well as the great successes achieved and to compare them with the tasks that are before us. We turn now to the future. We know that the chemistry program is of great significance to the victory of socialism in the GDR, and we are full of courage and enthusiasm. Our courage is the courage of the conviction that the workers of our chemical industry, who have successfully climbed the steep

path of the chemical industry from 1949 until today and have acquired greater knowledge, greater know-how, and greater self-assurance with each step, will bring the great chemistry program, which starts under infinitely better conditions, to a successful end.

Footnote

[1]We refer in this connection to an article published in our issue No 10 of 1959, entitled "The Caffeine Production Installation of the VEB Radebeul Chemical Plant As an Example of the Building Up of the Pharmaceutical Industry of the German Democratic Republic." Unfortunately, it was impossible because of the deadline to include this contribution in the Anniversary Issue. [Editor]

1331

EAST GERMANY

The Development of Personnel for the Chemical Industry

[This is a translation of an article by Wolfgang Goebel of the State Secretariat for Advanced and Technical Schools, in Chemische Technik, No 9, September 1959, Berlin, pages 473-474; CSO: 3276-N/2]

Since the founding of the GDR, great efforts have been made by the universities and the technical and trade schools to provide the people-owned industry with not only sufficient but also technically superior engineers, natural scientists, and economists. Although approximately 2,000 certified chemists (Diplom-Chemiker) and 5,000 certified engineers (Diplom-Ingenieure) have graduated from our institutions of higher learning since 1949, it is apparant that far from enough staff personnel is available to attain the ratio of professional and technical personnel to the total labor force that was called for by Walter Ulbricht at the First German Chemistry Conference. Thus, all universities and technical schools are faced with the task of training, in minimum time, a much greater staff of technicians, scientists, and economists for the chemical industry within the next few years.

In order to achieve this, it is necessary to develop new forms of study in addition to those already in existence. These forms must have the following characteristics:

1. The students will not be removed from production.

2. The material learned must be immediately usable in practical work.

3. The correlation of theory and practice must be at its optimum during training.

4. The guidance during the laboratory sessions and exercises must be so intensive that the studies are completed within the shortest possible time.

5. The new study plans must be adapted to each subject and to the possibilities of the training institution. Any type of schematization is to be avoided.

What bases have been created since the existence of the first German Worker-Farmer State for the achievement of the plans by 1965? What has to be done during the coming years?

New Training Institutions

Destroyed institutes and engineering schools were a heritage from the Nazi regime. It was thus essential to rebuild the destroyed and damaged institutes of learning. Beyond this, completely new universities and engineering schools were built. The enumeration of a few examples should suffice. New institutes for inorganic and organic chemistry, capable of accommodating 100 chemistry students each year, were built at the Karl Marx University in Leipzig and at the Martin Luther University in Halle-Wittenberg. A completely new complex of buildings was erected at the Mining Academy (Berg-Akademie) in Freiberg Sa. This complex houses all chemical departments and has also made it possible for the last few years to train certified chemists at Freiberg. New technical schools have been created in Karl Marx Stadt, Ilmenau, Magdeburg, and Merseburg, which train certified engineers in machine-building, electronics, chemical instrument building, system engineering, as well as certified chemists. The graduates of the technical schools mentioned above play a decisive role in the chemistry program.

The Polytechnical Institute for Chemistry (Technische Hochschule fuer Chemie) in Leuna-Merseburg is already today the largest training center for chemists in Germany ; 160 chemistry students register there yearly. This number will soon increase to 200. The building of the Faculty on Metabolism will be practically completed by 1965. There has been a Department of System Engineering at this polytechnical institute since 1958. In 1959 this institute will admit for the first time 100 full-time students who will receive for the time being their basic training at the Polytechnical Institute in Dresden and also probably 50 evening students. From 1960 on this department will admit 200 full-time students each year. In this manner the urgent demand for system engineers in the chemical industry will be satisfied in a foreseeably short period of time. At the same time the employees of the chemical industries located in the vicinity will have an opportunity to change their qualification from chemical engineer to certified engineer of system engineering by enrolling in the evening program. Furthermore, the Polytechnical Institute trains about 80 economists for the chemical

industry per year. Approximately 2,000 students will be enrolled in the three departments of the Polytechnical Institute by 1965.

Completely new chemical institutes will also be built at the Rostock University. New chemical institutes and teaching facilities are also being added to other polytechnical institutes and technical schools; and existing facilities are being enlarged.

New Spirit, New Content, and New Study Forms

The ideological discussions in which socialist technicians are trained have resulted in a new spirit at the polytechnical institutes and technical schools. This is especially apparent in the new forms and the new content of the studies. The socialist education principle has succeeded!

The individual program of study, in effect until now, is gradually being replaced by collective studies. The work in the seminar groups has improved so much that the first collective could participate in a competition for the title "Group of Socialist Students." The first results have already become apparent, although the socialist collectives have existed only for a short period of time. For instance, the students of what is now third-year chemistry at the Martin Luther University in Halle-Wittenberg were the first to carry out a new type of factory training program, which was then taken, in an improved form, during the summer months by the students of the Humboldt University in Berlin. This new program of correlation of studies and practice was developed for the students of Halle by Prof Dr Runge, to whose technical direction much of the credit for the success of this training program is due. The preparation and supervision of this program for the students of Berlin was in the hands of the certified chemists, Heinz and Hertzog, of the First Chemistry Institute. All the students who are now in third-year chemistry at the Halle University finished their practical work one month ahead of schedule. In this extra month the completed additional practical work, so that this socialist collective achieved a higher level of training. This achievement has become the goal of many groups, and it is certain that no student will exceed the planned time of study during the next year.

Just as the workers in industry struggle to achieve or exceed their plans, the faculty and students of the polytechnical institutes and technical schools fight together to finish their studies in the allocated time, and at the same time raise the scientific level and decrease the number of students who drop out during the course of the studies. Next to professors and docents, the assistants play a big role in the realization of this aim. Since detailed timetables have been drawn up for the inorganic and organic laboratory exercises, the actual time of study now usually corresponds to the time allocated in the study plan.

Consequently, industry now receives its highly qualified cadres, who have a close tie with our worker and farmer state, in the time planned.

Through the institution of the so-called contract research between academic institutions and industrial enterprises, a new possibility has been created to make the students, especially on the diploma and Ph.D. level, aware of the practical problems. The "industrial candidacy" ("Industrieaspirantur") which was created jointly by the Chemical Society (Chemische Gesellschaft) of the GDR and the State Secretariat for Universities and Technical Shools (Staatssekretariat fuer das Hoch- und Fachschulwesen) is to investigate particularly the problems of contract research, so that there will be a continuous transition from training to practice. Unfortunately, it is apparant that so far too little use has been made of this training possibility.[2] It is the goal of this candidacy to provide industry with graduate chemists in as short a time as possible.

Cardinal Points until 1965

Many new things have been created within recent years which imperatively demand new forms. For this reason, the Scientific Council for Chemistry of the State Secretariat of Universities and Technical Schools developed a new curriculum which puts the new content into a new form, and which at the same time permits greater freedom in carrying out the various courses. It is especially important that the training be more closely associated with practice. The next few months and years are decisive for the new form of the chemistry curriculum, which is to take five years and is also to raise the scientific level of the students.

Aside from the correspondence program, which has been directed for years by the Polytechnical Institute in Dresden and has already shown good results, as well as the full-time study program, new forms of training will be developed by the universities and technical and trade schools. These new forms of training will be tried first at the following institutions: Martin Luther University in Halle-Wittenberg, Karl Marx Stadt in Leipzig, Humboldt University in Berlin, Polytechnical Institute for Chemistry in Leuna-Merseburg, and the "Joliot Curie" Chemical Engineering School in Koethen. The above institutions work partially in conjunction with the factory academies (Betriebsakademien) now being developed. This new form is a type of evening training program which previously did not exist for chemists and system technicians. A combination of evening programs, correspondence courses, and full-time programs are also provided.

Special attention is to be given to a still further improvement of the training in mathematics, economics, organization, and planning of the people-owned chemical industry, as well as analytical, general, inorganic, physical, and technical chemistry. The training [program] in technical chemistry of the Polytechnical Institutes and at the Martin Luther University in Halle-Wittenberg can be considered adequate. At the other universities efforts must be made to see that lectures are given by persons with practical experience, or if this is already the case a technical laboratory must be built up. In the latter event, special consideration is to be given, especially at the polytechnical institutes, to the expanding petrochemistry, and to the chemistry and technology of high polymers.

Analytical chemistry has to be considered from an entirely point of view. In Germany, analytical chemistry has not been given its full value for decades. This neglect must be eliminated as rapidly as possible. The aspects of analytical chemistry are so manifold today that special measures have to be taken. Aside from a larger number of analytical chemists, it is essential to build up independent institutes for analytical chemistry. The entire field of analytical chemistry is to be taught and investigated at these institutes--that is, the division between inorganic and organic analysis is to be destroyed, and the physical and physico-chemical methods as well as the methods of semimicro-, micro-, and ultramicrochemistry which have been established over the past years and decades are to be introduced and developed further. The significance of analytical chemistry in the development

of automatic production plants is not to be overlooked or underestimated. In this connection, analytical chemists who work at universities and research institutes are faced with new and challenging problems.

Table 1 gives the training of certified chemists and certified engineers of system technology (Diplom-Ingenieure der Verfahrenstchnik) as a numerical illustration of the future development of cadres in the GDR.

Table 1

Specialized Field: Chemistry and System Engineering

	New Admissions		Graduates	
	1951-1958	1959-1965	1951-1958	1959-1965
Chemistry:				
Full-time	4,446	5,600	1,600	4,000
Correspondence and other forms of training	1,148	1.700	48	650
System engineering:				
Full-time	295	1,520	100	450
Correspondence and other forms of training	-	400	-	100

These figures are surpassed by far by the figures planned for the training of the other technical cadres. For instance, more than 7,500 students in specialty machine-building (without technology) will be registered from 1959 to 1965.

The victory of socialism in the GDR depends first of all on how we are able to develop the necessary cadres. The development of the cadres is the key to the solution of the economic problems.

Footnotes

[1]See Chemische Technik, No 10, 1958, page 603.

[2]Compare Mitteilungsblatt der Chemischen Gesellschaft in der DDR, No 6, 29, 1959.

1331

EAST GERMANY

The Development of the VEB "Walter Ulbricht" Leuna Plant

[This is a translation of an article by Wolfgang Schirmer in Chemische Technik, Vol 11, No 9, September 1959, Berlin, pages 501-505; CSO: 3276-N/3]

The extensive chemistry program of the GDR and the resolutions of the Chemistry Conference that took place in November in Leuna focussed public attention on the importance of the chemical industry. Because of the demands to be made on this branch of industry during the next seven years, it has become of central importance to our entire economy. The planned production development falls into two stages:

1. In the 1958-1961 period, in which we are to achieve the main economic task--to surpass West Germany in the per capita consumption of foods and industrial goods.

It is known that it is planned to increase the production of the chemical industry by 33 percent above the 1958 level by that date. The main problem is that this production increase should be made mainly in the installations that are already in existence, since the great investment plans already initiated will not yet be productive.

2. In the 1961-1965 period, in which new chemical enterprises are to be built and the existing plants enlarged, equipped with the most modern technological equipment.

In this period, the production of the chemical industry is to increase by another 60 percent.

In this development, the VEB "Walter Ulbricht" Leuna Plant, which produces about 10 percent of the total output of the chemical industry of the GDR, has a large share. The production is to increase from a value of 752 million DM in 1958 to 1,600 million DM in 1965--that is, by about 113 percent (figures calculated on the values established by the plan). The following table reviews the actual or planned production development from 1936 to 1965. These figures are also calculated in comparable plan values.

The production was or will be as follows:

	Million DM
1936	410
1943	730
1945	30
1950	275
1954	510
1957	683
1958	752
1960 plan	920
1961 plan	1,010
1963 plan	1,350
1964 plan	1,600

As is apparent from Figure 1, the production was at a maximum during the Second World War in 1942 and 1943. This, however, was achieved by having the industry completely attuned to the armament needs of that period for the production of high grade gasoline for aviation and highly concentrated nitric acid and other strategic products. Eighty percent of the plant was destroyed through the bombings that started in 1944, and the production decreased to a minimum in 1945.

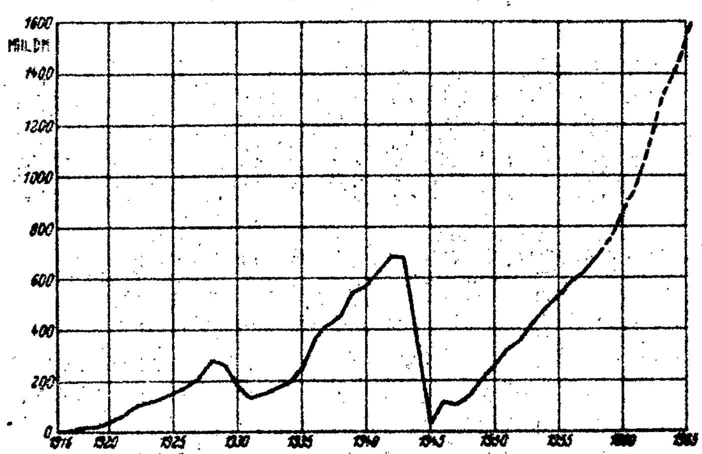


Figure 1

Development of Market Production of the Plant [in million DM]

———— 1916-1958 actual

-------- 1959-1965 planned

After the changeover to a Soviet joint-stock company, the plant was sytematically rebuilt from 1946 on under the technical direction and with the help of Soviet chemists and engineers. The removal of 200,000 tons of debris,rubble, and waste; the gradual resumption of synthesis in the various plants; and the reorganization of production for the needs of our population and the peacetime economy of the GDR made great demands on the personnel, the workers, the artisans, the engineers, and the chemists. Under the harshest conditions, insufficient-

ly clad and nourished, tens of thousands daily accomplished excellent work in putting the complicated production installations back into operation. They thus created the prerequisite for the building of the important economic foundations for our worker and farmer regime.

The yearly production increase was 13 to 15 percent from 1950 to 1954 and 7 to 9 percent from 1954 to 1958.

It is known that the enterprise consists of three different production branches:

1) The inorganic section, whose main products are nitrogen and nitrogen-containing fertilizers.
2) The hydrogenation division, which deals with the production of gasoline, Diesel fuel, and gaseous hydrocarbons.
3) The organic division, which produces a large number of organic compounds, at the moment about 250.

The following table gives the past or future share of the production of these three main branches:

	1936	1943	1957	1958	1961	1963	1965
	(in percent)						
Nitrogen or nitrogen products	41.3	22.7	31.1	28.2	26.7	24.7	17.7
Hydrogenation	45.0	49.0	36.0	34.0	37.3	33.7	42.6
Organic division	6.4	20.9	26.2	27.5	27.0	33.9	34.2
Other products	7.3	7.4	6.7	10.3	9.0	7.7	5.5

It is apparent that the composition of the production of the Leuna Plant has changed considerably over the past 20 years. The percentage of the production of nitrogen and nitrogen-containing fertilizers has decreased, while the percentage of production in the organic division has increased steadily. This trend will also be maintained in the future. In 1965, only one-sixth of the output of the plant, which was founded 40 years ago in order to manufacture nitrogen according to the Haber-Bosch process, will consist of these products. However, the ammonia plant planned for that time will have a productive capacity of 525,000 tons per year and will certainly be one of the most significant installations of that type in the world.

The products of the organic division will become steadily more important for the total production. The role of hydro-

genation will also increase, although only after a modification of the procedures used. The diversified character of the plant, which is already quite pronounced today, will be strengthened further through the introduction of new products.

More than 100 new products have been incorporated into the manufacturing process since 1945. Some of these are special glues and adhesives, such as K-glue and clamping plate adhesive (Spannplattenleim), caprolactam and polyamides, formamide and dimethylformamide; 30 different products for the pharmaceutical industry, such as isonicotinic acid hydrazide, chloroprocaine, salicylic acid, and others; alkyl and aryl amines of the most varied composition; pest control and weed-killer products, urea, dimethyl-uric acid and hydrazine; various types of carbonyl iron powders; and numerous other products. The value of these products newly introduced into production was 28 percent of the total production in 1958.

More new products will be incorporated into our permanent production program between 1959 and 1965. Among these are argon, high-pressure polyethylene, epoxy resins of varied composition and usefulness; mono-, di-, and epichlorhydrin, Dian, powdered K-glues, special adhesives for the most varied applications, alkylaryl sulfonates, alkylbenzine, synthetic phenol, urea resins of the most varied composition, and numerous other products which are still the object of industrial research. Furthermore, it is planned to resume the production of ammonium sulfate-nitrate, which was very popular for agriculture before the Second World War.

The development of the Leuna Plant has thus been geared consciously since the outset in 1945 toward the formation of a combine whose main function is to produce chemical raw materials and intermediates based on syntethic gas production from lignite, the processing of imported petroleum, and the manifold production of the organic division based on these.

The production of compressed gas, especially compressed hydrogen, is characteristic of the production of the Leuna Plant. Leuna soon grew into a large chemical enterprise applying pressure reactions of all kinds on a large technical scale. For example, the following products of our present production program are obtainable only by means of pressure reactions, the pressure varying between 50 and 1,500 atmospheres:

Ammonia (see Figure 2)	Monomethyl amine
Gasoline	Dimethyl amine
Diesel oil	n-butyl amine
Fuel gas	Formamide
Propane	Dimethylformamide
Butane	Mepasin
Methanol (see Figure 3)	Urea
Isobutylalcohol and other products of the isobutyl oil syntheses	Carbonyl iron
	High-pressure polyethylene

The pressure reactions carried out on a large scale, mostly with permanent catalysts built into the system, became a model for our processing technique. The continuously operating high-pressure furnaces designed for large charges, and the numerous apparatuses necessary for the purification of synthetic gases and their preparation for reactions are typical of our plant. These procedures also need extensive research on heterogeneous contacts.

Another feature characteristic of our production is that our products are used as raw materials in other plants. Thus, for example, the share of our plant in the total production of the GDR of the following raw materials is given below:

	Percent
Ammonia	100
Urea	70*
Alkyl amine	100
Methanol	100
Formaldehyde	30**
Phenol	80
Higher phenols	85
Ethane	100
Propane and butane	55

*After 1961, 100 percent
**After 1962, 50 to 60 percent

This development has to follow from an economic analysis of the suitability of the expansion of our plant. If we proceed according to theprinciples of the highest yield, the planned production increases for these raw materials must be carried out in our plant. Thus the quantities of raw materials available will lead to further internal production

relations, which we shall have to develop as advantageously as possible for the benefit of our economy.

Thus, for instance, the decision of the State Planning Commission to concentrate the manufacture of salicylic acid in Leuna because cheap phenol and gaseous CO_2 of suitable quality are available there is based on economic considerations of profitability.

The same principles entered into the decision to locate phenol sythesis by the cumene procedure in Leuna, because propylene, which is a necessary raw material for cumene synthesis, will be available there from 1963 on as a consequence of the expansion of the plant. A further advantages is that the treatment of the phenol-containing waste waters can be carried out in the available purification installations.

A close examination of the perspective plan of the chemical industry shows that until 1965 our plant will have to bear the principal burden of the production development of the chemical industry, and that the new plants which will be built will start production only in the last years of the Seven-Year Plan or even later.

Special Developmental Problems of the Leuna Plant

The figures for the perspective development given below correspond to the present state of the plans. Since several expert opinions on economic significance have not yet been received, some change in the figures can still occur.[1]

Production of Ammonia and Nitrogen-Containing Fertilizers

The development of the ammonia production is to reach about 525,000 tons per year of NH_3 = 432,000 tons of N in 1965. This level is not to be exceeded. We d em it without purpose to develop our installations further, since we do not have the prerequisites for the necessary power supply for further expansion. The synthetic gas production is gradually to be based completely on low-temperature lignite coke. Anthracite coke, which is still used to the extent of 50 percent, is to be used for other production purposes in the GDR.

One of the principles of nitrogen fertilizer production is to produce more nitrate-containing fertilizers instead of ammonium sulfate. One of our tasks is to build and put into operation--at the latest by 1965--a plant for the production of ammonium-sulfate-nitrate with a yearly output of 42,000 tons of nitrogen.

Hydrogenation

The hydrogenation [plant] processes today about 650,000 tons per year of petroleum and 100,000 tons per year of other liquid raw materials (light oils from low-temperature lignite carbonization) as well as 200,000 tons per year of lignite, which gives, after hydrogenation and purification, about 750,000 tons per year of products such as benzine, Diesel fuel, liquid gases, gaseous hydrocarbons, and heating oil.

The procedure used at present is characterized by the following:

The work in the pressure chambers is carried out at a pressure of 250 atmospheres of hydrogen. The hydrogenation of lignite requires approximately 2,500 cubic meters of hydrogen per ton of gasoline, while the hydrogenation of petroleum only requires about 400 to 500 cubic meters per ton of the final product. However, since compressed hydrogen is a relatively expensive product and its productive capacity now determines the volume of production of the entire plant, we have to make every possible effort to decrease the hydrogen consumption. We obtain almost sulfur-free products by means of rigid purification procedures. The Diesel fuels are characterized by their high ignition quality and their antifreeze quality.

Through careful operation of the coal chamber we obtain a relatively high phenol yield from this portion of the hydrogenation. The disadvantages of the procedure lie, aside from the high consumption of hydrogen, in the relatively low octane number of the produced gasoline, in the insufficient use of the valuable lubrication oil fractions of the petroleum, and in the yield of heavy residue oils which cannot be reworked after this procedure.

A minimum program was proposed for the further development of the hydrogenation division. This program is not designed to surmount all the above-mentioned shortcomings of the actual procedure but will result in a considerable production and capacity increase.

The following measures are to be taken:

1. The operation of the coal chamber is to be suspended before the end of 1959. The hydrogen that becomes available in this manner will be used to process more petroleum.

2. The L-forming installation (modified platforming procedure), which was put into operation at the beginning of 1959 as an experimental plant, is to be used as a production plant as soon as possible and developed to its full capacity.

It is estimated that this installation will produce about 200,000 tons per year of gasoline with a base octane number of 78 and an aromatic content of 25 to 30 percent.

The mixing of this platform gasoline with that produced by current technology will probably give us an average gasoline with a base octane number of about 72 by 1960, which can, in case of need, be changed into a gasoline with an octane number above 80 by means of the usual additions of tetra-ethyl lead.

3. Increase of the total production from 1960 or 1961 on to a processing capacity of 900,000 to 1,000,000 tons per year of petroleum, without additional hydrogen consumption.

It can even be envisaged that the consumption of hydrogen will decrease as a consequence of the suspension of the coal chamber. This will depend on the type of petroleum used. The quantities of hydrogen that will become available in this manner are to be used for ammonia synthesis.

This minimum program has still many shortcomings from the technological point of view. Thus it would be expedient to change over to middle-pressure raffination procedures for the further development of the petroleum processing in Leuna, and if possible subject the entire gasoline output to an aromatic formation procedure (L-forming procedure).

Finally, we should find a way to prepare the lubricant oil fractions of the petroleum processed at our plant for the

preparation of lubricants by the neighborin VEB Petroleum Plant in Luetzkendorf.

However, all these changes are associated with large investments and they have to be postponed because the means are needed for still more important production increases.

The hydrogenation division of our plant is aware that it has to bear the principal share of the responsibility of satisfying the increasing demand for gasoline and Diesel fuel for the GDR until 1963. Then the planned petroleum processing plant in Schwedt is to start production.

Through the formation of socialist research unions in all plants of this division, and through the close cooperation of the workers and the intelligentsia, new ways are constantly sought of making the production still more profitable and technically more perfect, with the least possible amount of investment.

Production of Plastics and Plastic Precursors

The production of organic chemical raw materials and heavy chemicals is becoming increasingly important. Since the chemistry program gives great importance to the development of plastics and raw material for synthetic fibers, we also have to fulfill new tasks in this field, some of which will be detailed below.

Development of the Production of Caprolactam

The plant, which today has a maximum operating capacity of 8,000 to 9,000 tons per year, is to be increased to a capacity of 23,000 tons per year by 1965.

The procedure generally used in our plant for the production of caprolactam is represented in Figure 4.

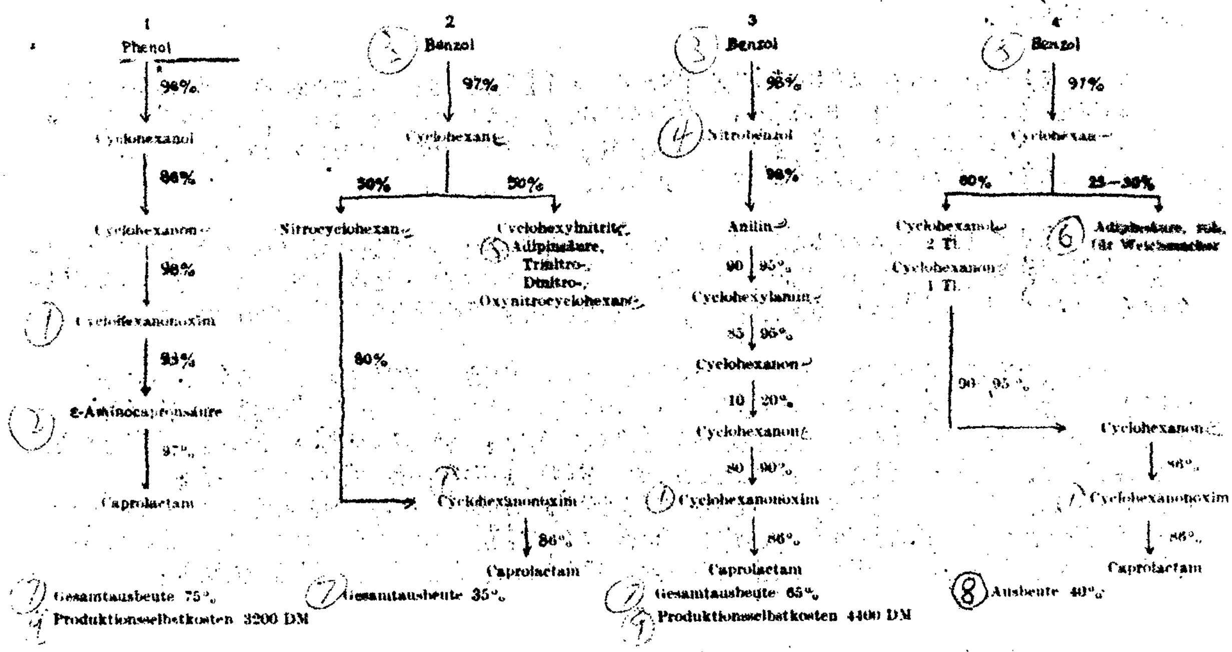


Figure 4

Procedure for the Preparation of Caprolactam by Four Production Processes

1) Cyclohexanone oxime
2) ε-aminocapronic acid
3) Benzine
4) Nitrobenzine
5) Adipic acid
6) Adipic acid, crude for solvents
7) Total yield
8) Yield
9) Production cost

Starting from phenol, we obtain caprolactam in five steps. However, since phenol, which we obtain for the moment exclusively from the crude acids of lignite low-temperature carbonization and from phenosolvan extracts, is not available in unlimited quantities, we have to look for other sources. Taking into consideration all economic and politico-economic factors, we came to the conclusion that a phenol synthesis especially based on the cumene procedure was most profitable for our enterprise, especially since, in view of other technical developments, we will also have propylene at our disposal. If we have to start caprolactam synthesis directly from benzine, we would consider Schemes 2 to 4. Scheme 4 especially, which is at present in the research stage, offers great technical possibilities because of the few intermediary steps and the direct oxidation of cyclohexane, if it is possible to eliminate the difficulties encountered in the working of the

oxidation mixture. If the resulting fraction of adipic acid can be obtained pure, it could serve as a basis for solvent production.

The procedure starting from aniline is already in use on a large technical scale. However, since we do not have aniline at our disposal in the GDR, this procedure does not enter into consideration for us.

We plan to increase the caprolactam production by proceeding along the projected path. The procedure has been simplified over the past years by numerous technical measures.

The development of a system for the synthesis of phenol will make this raw material, which is so important for the development of the plastics industry, available in sufficient quantity. In this instance we can lean on the experience of the Soviet Union, which already uses the cumene procedure on a large technical scale and is willing to put the available technical data and documentation at our disposal.

Gaseous Olefins and Paraffins

Our enterprise has been given the task of supplying our economy with gaseous olefins and paraffins at least until 1965. The separation of ethane and propane to ethylene, which is the procedure presently used at Leuna, is based on the pyrolysis of paraffins by means of partial combustion of the hydrocarbons through the admixture of specific quantities of oxygen.

Since the procedure utilizes waste gases or products of hydrogenation, it can only be enlarged within certain limits. We estimate that by this procedure we will be able to produce 15,000 tons per year of ethylene by 1962. Since, however, the need for ethylene in our republic is increasing considerably, and since one of the tasks of the Leuna Plant is to ensure the supply of ethylene to the VEB Chemical Plant in Buna, which is still manufacturing ethylene by partial hydrogenation of acetylene, the ethylene production of our enterprise has to increase to almost 100,000 tons per year by 1965. We plan to accomplish this by the introduction of a modern separation procedure for which gasoline or heavy gasoline fractions will be available. A final decision on the procedure that is to be constructed has not yet been reached. It is, however, planned to choose a procedure that will permit

us to obtain, apart from the desired olefins, condensation oils with a high content of aromatic substances.

The separation procedure that is being considered will yield, aside from approximately 30 percent ethylene, 8 to 9 percent propylene, which can then be used immediately in the cumene procedure.

Half of the ethylene produced in our enterprise by 1965 will be sent to Buna; the other half, however, will be at the disposal of our enterprise for further processing.

We plan to use it chiefly for the production of high-pressure polyethylene. We thus have another procedure which corresponds to our experience in the high-pressure field. The experimental installations that we created by our own means have given us the possibility of producing high-pressure polyethylene by large-scale techniques. It now depends on whether our machine-building and construction industry will be able to put the necessary equipment and buildings at our disposal.

Formaldehyde Production

Another task in the field of the production of raw materials for the plastics industry is the development of formaldehyde production from a capacity of about 10,000 tons per year in 1959 to about 29,000 tons per year in 1965, by means of procedures that are based on known principles and have been improved by our own research.

Finally, let us again consider the quite extensive development of formamide production, which is to increase from a capacity of barely 4,000 tonsper year in 1959 to almost 20,000 tons per year in 1965, and is thus to make an important contribution to the planned development of Wolcrylon fiber.

Behind the figures of the production development of the "Walter Ulbricht" Leuna Plant during the future Seven-Year Plan are hidden extremely great demands which will require the constant efforts of the 30,000 workers, foremen, engineers, and chemists of our enterprise. We do not underestimate the difficulties which can occur in the realization of the planned program, but we are beginning our tasks with optimism, since we know that we will be able, through the

socialist structure of our society and the support of the entire population of our republic, to concentrate all our forces on the achievement of our task. With the help of all workers, we will succeed in fulfilling the chemistry program.

Footnote

[1] Thus, for instance, certain of the steps to be taken for the hydrogenation--which are mentioned in the text below--are still under discussion and still have to be finally approved by the State Planning Commission.

Photo Captions

Figure 2. High-Pressure Containers of Ammonia Synthesis.

Figure 3. A Methanol Still.

1331

EAST GERMANY

The VEB Chemical Plant in Nuenchritz

[This is a translation of an article by Gerhard Walther in Chemische Technik, Vol 11, No 9, September 1959, Berlin, pages 505-508; CSO: 3276-N/4]

The German chemical program also set tasks for the VEB Chemical Plant in Nuenchritz which will require the efforts of all the personnel of our plant if they are to be realized during the next seven years. Our part in the battle for the victory of socialism is determined by the following principles:

1. The rate of development of the chemical industry must be increased vastly, so that it will be possible, through a greatly increased production of important chemical basic materials and finished products, to bring about a considerable improvement in the supply of other branches of industry with raw materials and accessory materials and in the supplying of the population with consumer goods of high quality.

2. In the solution of the problems it is important not to scatter the means placed at our disposal by the state.

3. Human labor is to be saved as much as possible, by reconstructing existing enterprises and improving the administration and the work organization as well as through the application of the newest technical insights in the construction of new industrial installations.

4. The application of the most stringent economy measures in the production of chemicals is a significant contribution to the tasks set by the Party and the government.

5. The workers in our plant are to participate more than heretofore in the planning and management of production as well as in the realization of the investment program.

6. For the working out and realization of the plans by 1965, all members of the plan are called upon to participate in the discussion of the plans and take an active part in the build-

ing up and expansion processes so that all available production possibilities and reserves will be utilized to the utmost for the realization of the chemical program.

The Development of Production in the Seven-Year Plan

Changes in the Character of our Plant through the Expansion of the Production Program and the Increase of Production

We chemical workers of Nuenchritz can look back with pride upon the successes already achieved. Table 1 shows the development of our plant since 1950.

Table 1

Development of Production from 1950 to 1958 (in percent)

Year	Sulfuric Acid	Sodium Hydroxide	Hydrochloric Acid	Chlorosulfonic Acid	Bleaching Lye	Silicones
1950	100.0	-	-	-	-	-
1951	113.8	100.0	100.0	-	-	-
1952	110.1	147.7	229.6	-	-	-
1953	130.2	150.3	293.1	-	-	-
1954	135.1	154.1	355.1	100.0	-	-
1955	143.2	163.0	360.0	122.9	-	-
1956	147.5	163.1	356.0	162.4	-	100.0
1957	150.2	175.0	354.0	179.0	100.0	377.8
1958	151.6	168.9	300.0	158.0	188.4	441.6
					246.8	601.6

While during 1950-1958 our production was focused on making sulfuric acid and caustic soda as well as the derivative products "special acid," chlorosulfonic acid, bleaching lye, and hydrochloric acid, the production of silicone products has been gaining in importance since 1956 and will steadily continue to do so until 1965 and presumably also after 1965. The continual increase in the output of silicone products in 1960-1965 and thereafter will have decisive influence on the character of our plant, as may be seen from Table 2.

Table 2

Change in the Production Output in Favor of the Production of Silicones with Relative Retrogression in the Production of Inorganic Basic Chemicals for 1959 to 1965 (in percent)

Year	Sulfuric Acid Enterprise	Electrolysis Enterprise	1 + 2	Silicone Enterprise	Plant
1959	23.6	33.2	56.8	43.2	100.0
1960	24.2	27.5	51.7	48.3	100.0
1961	23.5	26.6	50.1	49.9	100.0
1962	23.3	26.4	49.7	50.3	100.0
1963	16.6	18.1	34.7	65.3	100.0
1964	10.5	12.5	23.0	77.0	100.0
1965	10.3	15.0	25.3	74.7	100.0

The realization of our goals by 1965 requires exertions on our part which must be concentrated on the following important points:

1. Broad development of the socialist contest and all-around use of socialist working methods in all fields of enterprise.

2. Critical analysis of the work processes in production and of management for the maximum utilization of the available capacity and for the reduction of costs.

3. Improvement in the quality of our products through the collaboration of scientists and experts.

4. Continuous training of our female and male colleagues in order to introduce them to the most up-to-date technology, so that it will be possible to use it in production.

5. Conscientious adherence to the plans for the development of cadres in order to supply the various parts of our enterprise with the necessary trained workers and scientists and in order to raise the average age of all categories of employees.

Significance of the Products of our Plant for the People's Economy

Production of Basic Chemicals

Recognizing that the maximal economic significance of chemical production sites requires the highest possible refining of the basic and auxiliary chemicals, it can be seen that up to about 1958 almost all our main products at the time--sulfuric acid, sodium hydroxide, and their derivatives--were put on the market. The planned increase of silicone production by 1965 and in the following years will increase our own use of the above-mentioned basic chemicals, so that in the future we will achieve a considerably higher level of refining. In addition, during the course of the Seven-Year Plan it is planned to build an absorbing clay plant next to our plant, which will also use considerable quantities of our basic chemicals and work them, together with Hungarian alumina, into a filtering material for the oil and margarine industries of the GDR.

As a result of the planned development, the Chemical Plant in Nuenchritz will show a regressive development with regard to the marketing of basic chemicals so as to have a larger output of the more valuable chemical products.

Significance and Development of the Production of Silicones

The element silicon may be used like carbon for obtaining high polymers which resemble organic synthetics in many respects if the silicon is alternated with oxygen in the formation of chain, ring, or network type basic units. The silicon-oxygen basic structure causes the silicones to be considerably more heat-resistant then carbon synthetics. To this outstanding thermic property of this synthetic may be added the possibility of working it into plastics and into liquids of the most varied viscosities. The above-mentioned properties result in the wide range of silicon-products, of which the following may be mentioned as typical representatives:

a) low-viscosity silicone liquids in the form of silicone oils;
b) plastic-elastic silicone rubber; and
c) more or less solid and hard silicone resins in the form of various types of lacquers.

Since our era is characterized by a vigorous development of technology, mechanization, and automation, it is absolutely necessary to utilize all the insights of basic research to speed up this vast progress and to build up the corresponding productions.

The requirements for improvement and reduction of cost in the technologies of lubricants, corrosion protection, separation, insulation, impregnation, and coating--to mention the most important fields in which silicones are applied--was not satisfied sufficiently in the past. The closing of this gap in the course of the current Seven-Year Plan is one of the tasks set for the VEB Chemical Plant in Nuenchritz. It must be emphasized that the implementation of this program has not only national importance but also a very real international one. International discussions within the socialist camp have determined that the production of silicones is to be developed in the USSR and in the GDR, with the production of the Soviet Union to cover its won needs and the GDR to supply the other socialist countries and capitalist foreign states as well as to cover its own needs. The silicone exports already taking place from our plant and the greatly increased ones planned for the future offer an excellent opportunity for producing valuable export goods from plentiful local raw materials; the international price for the products, depending on the type and quality, ranges from 15,000 to 20,000 DM per ton of product.

It must further be pointed out that great efforts will be required of the socialist sector if it is to reach the international level of silicone production. According to semi-official disclosures, the USA produces about 17,000 to 18,000 tons of silicone products yearly, of which about half is silicone rubber.

In the GDR the Institute for Silicone and Fluorocarbon Chemistry was founded in Radebeul near Dresden only since 1945 for the development of this industrial branch; its specific task is the study of silicone chemistry. It was only in 1954 that the VEB Chemical Plant in Nuenchritz was able to start operating a pilot installation which is used for large-scale technical experiments and is to be replaced in 1963 by a large-scale technical installation.

The Investment Program in Our Plant

The reconstruction measures to be undertaken by 1965 may be divided into two main divisions:

a) overhaul, modernization, and enlarging of already existing installations; and
b) building of new installations.

In accordance with the goals set by our economic organs, the already existing aggregates, buildings, and machine installations for the production of basic chemicals will be overhauled, modernized, and slightly enlarged during the course of the Seven-Year Plan.

In this undertaking, the simplification of the work process, the savings in manpower, and the reduction of production costs through a constant search for the most rational technology will be of decisive importance. Teh enlarging of the supply facilities of our plant is also important, since in accordance with the present state of the installations they are geared to a considerably smaller capacity than the one planned for the future. Corresponding with the enlarged capacity brought about by the investments planned until 1965 and after, it is necessary to renovate and enlarge accordingly our power production, water supply and disposal, social measures, and technical-administrative procedures.

Nearly 50 percent of our investment volume is for the building of a new silicone installation, to proceed in two steps.

After the initial preparation, this undertaking will have a decisive influence on our future production and all the indices connected with it, such as an increased number of employed, cost structure, accumulation, an increased volume of exports, assistance for the technical development of other industrial branches, and many other things.

It is the goal of the silicone project to replace the pilot installation, operating since 1954 and constantly being further developed, with the first phase of the building plan by 1 January 1963 and with the second phase by 1 January 1964. In this manner the production output as compared to the presently produced quantities will be increased to 150 percent for oil and to 250 percent for lacquer starting in 1963. Starting

on 1 January 1964 the increase with respect to 1959 will be 250 percent for oil and 500 percent for lacquer.

In the long-range plans it is already foreseen that there will be another doubling of the 1965 production figures starting in 1966.

These sober figures do not show the problems which must yet be solved before 1965. The technique being used in our present pilot installation does not yet correspond to the newest insights of research; the result of this is that at the moment the average production cost per ton of finished product is still about double the world market price. A decisive lowering of the costs can only be achieved by improved technology, lowered norms for materials used, and reduction in the amount of human labor in the production process. The construction and building up of large-scale installations must thus be determined by these indices.

Suggestions of the Chemical Workers of Nuenchritz on Building Up the Installations

Economic progress in our republic in all fields of public life requires people who, imbued with the realization of the victory of socialism, are willing to try new ways of organizing work. In order to achieve a unification of science and practice, we started goal-collectives and a research association in our plant. The members of these socialist work collectives are production workers and members of the intelligentsia of our plant, of the VEB KIB Chemistry, and of the Institute for Silicone and Fluorocarbon Chemistry at Radebuel.

Altogether three goal-collectives and one research association are working in our plant and concern themselves with the reconstruction measures of the following pasts of the enterprise: a) chloride enterprise; b) sulfuric acid enterprise; c) silicone enterprise; d) research on collective work.

All existing socialist work collectives have planned in detail those problems which thry want to solve, within the total reconstruction, by 1965, with deadlines and the naming of responsible parties. This guarantees that the overhauling and building up of our installations will not proceed from the "green manage,ent table" but rather that all connected with the enterprise will feel responsible inasmuch as they, as a result of their experiences in production, will be able

to take an active part in the investment program even during its planning stage. Today's builders of industrial installations thus become tomorrow's guiding organs for production.

In Nuenchritz a Decisive Turn Is Being Taken in the Direction and Guidance of Production

Socialist direction and guidance methods are determined primarily by collective cooperation with the workers. While it is true that this principle has already been heeded in the past, there was the fault that to some extent the work was left to its own devices. The realization of the German chemistry program requires a significant improvement of direction and guidance. For this reason we initiated in our plant the consistent adoption of the following measures:

1. Every week all the basic points of production and administration are discussed collectively in the plant-directing collective, and measures for the immediate removal of all deficiencies and weaknesses found are decided upon. All decisions are written douwn, and a deadline as well as who is to take responsibility are laid down. Decisions on hand are filed only after the elimination of the weaknesses outlined.

2. A plan which was drawn up for the plant in the beginning of July 1959 with the cooperation of the workers draws the attention of the individual areas of work to deficiencies of a basic nature, for the removal of which the efforts of the whole collective will be needed. Responsibility is transferred to the leaders of the technical sections in question upon being named by the controlling organ. At the predetermined deadline, the responsible parties are to report on the planned or suggested measures.

The basic points of the plan, which has as its goal the improvement of the present work and the support of the fulfillment of the Seven-Year Plan, are:

1) an improvement in the work of continual production counseling, which has as its most important task the raising of the productivity of labor;
2) steady control over the fulfillment of our duty on the occasion of the tenth anniversary of our republic;

3) an encompassing show of inventiveness and rationalizing, with the initiative of the masses oriented toward the following problems:

a) increased labor productivity, decreased production and material input costs, savings in manpower;
b) improved quality and increased obligations incurred in honor of the Tenth anniversary of our republic;
c) suggestions for the adoption of measuring and controlling devices which will save labor and simultaneously increase plan fulfillment. The special character of this contest is emphasized by the fact that prizes in the form of objects are given in addition to the legally payable monetary prizes.

4) continuous discussion and refinements of the already worked out long-range plan;
5) the working out of proposals for improving technology;
6) laying down of measures for improving the guidance and raising the political-ideological level of all employed in our plant;
7) our workers have recognized that an increase in production depends on consistent application of the socialist style of working. Their answer is the formation of socialist brigades and youth brigades.

Even now there are concrete proofs that the work of socialist brigades is a higher form of the socialist contest.

A further demonstration of the progressiveness of our staff can be seen in that:

21 colleagues achieved qualifications for exercising a second occupation;
24 colleagues are at the moment studying for such qualifications;
251 colleagues of both sexes are organizing and continually improving their work according to progressive working methods.

Much space in the discussions of the last few weeks was taken up by a discussion of the plan of operations until 7 October 1959, the tenth anniversary of our republic. The employees of the plant agreed in the spring of this year to have the state plan already 80 percent fulfilled in honor of the festive day of our republic. Production deficiencies in the first quarter, which were caused mostly by circumstances

beyond the control of our plant, left us behind with respect to plan fulfillment, but we caught up in the second quarter and were even able to get 1.1 days ahead of the plan by 30 June 1959. To safeguard our obligation we worked out a plan of operations starting 1 July 1959, which was binding for the whole plant. This plan provided mimum daily quantities for every product to be produced by us, and in sime instances considerably larger quantities than those mentioned in the intensificed state plan. A check on the plan of operations is kept daily by an operational staff, which includes production workers, members of the plant administration, and members of the BPO and the BGL [abbreviations not identified]. Any deficiencies uncovered in production are, insofar as possible, corrected immediately, and if this is necessary the VVB Electrochemical and Synthetics is drawn into the problem as the servicing headquarters. With the continued cooperation of all employees, this method of working will guarantee a continual overfulfillment of all parts of the plan. We can prove our expectations with the overfulfillment of the most important tasks set by the state plan which we achieved by 30 June 1959:

a) fulfillment of the production plan: 100.6 percent, 1.1 days ahead of the plan
b) fulfillment of the increase in labor productivity: 101.1 percent
c) fulfillment of the investment plan:
   1) expansion of the basic means: 51 percent
   2) maintenance of the basic means: 52 percent
d) fulfillment of the export plan: 56 percent
e) fulfillment of the finance plan:
   1) yield of the production merchandise at enterprise prices: 102.9 percent
   2) decrease in production: 7.24 percent as against a rise of 3.37 percent
   3) yield for the enterprise: 167,900 DM (167.9 TDM) as against a planned loss of 22,400 DM
   4) production delivered: 90 percent

Our course is set for 7 October 1959, at which date we [shall] report the following to our state:

1) a plan fulfillment of 80 percent;
2) a fulfillment of the investment plan of 70 percent;
3) a one-percent saving of investment means per project;
4) the completion of the projects ahead of the deadlines while keeping costs below those planned;

5) a fulfillment of the project plan of 80 percent;
6) the putting into operation of the planned capacity ahead of the deadlines; and
7) a fulfillment of the export plan of 80 percent

Our desire for the fulfillment of the plan is expressed in the fact that when the operating plan was laid down it was also suggested that the distribution of premiums be changed in such a way that the premiums from the cultural and social fund for the sedond and third quarters of 1959 not be distributed before 7 October but rather on the feast day of our republic according to the contribution of each individual to the common success. Although, according to the legal provisions, the premiums are supposed to be distributed by the 25th of the month immediately following the end of the respective quarter, we are trying with our proposal to encourage every employee to try to give his best so as to be able to set a fine birthday table for our republic.

It is true that in the foregoing exposition we did not touch upon all the problems which our plant is facing at present and will still face in the future. It seems much more important to us to show that we understand correctly the exhortation of our government--"plan with, work with, govern with"--and to convince people that our employees not only speak of it but also act accordingly.

Photo Captions

Figure 1. Partial View of a Silicone Installation.

Figure 2. Partial View of a Silicone Installation.

1024

EAST GERMANY

Theme and Organization of Work of the Institute of Synthetic Fiber Research in Relation to Practical Application

[This is a translation of an article by Hermann Klare in Chemische Technik, Vol 11, No 9, September 1959, Berlin, pages 509-513; CSO: 3276-N/5]

Problem and Organization

If we try to outline the task of the Institute for Fiber Research of the German Academy of Science in Berlin in one sentence, we may formulate it about as follows:

> Research in the field of macromolecular chemistry, using the methods of chemistry, physical chemistry, colloid chemistry, and phsics on natural and synthetic fiber-forming polymers, and their formation into synthetic fibers as well as their behavior and properties.

The task of the institute is thus limited both in the direction of raw materials and in that of application--i.e., as a rule no syntheses for obtaining new monomers and no work on the application of synthetic fibers are undertaken. In the same way the field of concern is almost exclusively that of synthetic fibers--i.e., natural fibers are introduced, if at all, only for comparison purposes.

A clear formulation and delimitation of the problem is necessary before the organization and subject matter of the studies--and especially the relations of these studies and their results to practice, i.e., to the synthetic fiber industry--can be discussed.

Every institute in the natural sciences which is concerned with research and development faces an important basic problem, regardless of the specific nature of the technical field. This is tge question of a correct choice of topic and of a functioning organization of scientific work, which in the last analysis must lead to the quickest possible practical applica-

tion of the results so that they will become immediately useful.

This requirement for the quickest possible practical application of research results is, however, in no way to be interpreted as meaning that long drawn-out basic research is to be condemned a priori; this would indeed be a fateful mistake!

It is much more a question of arranging and choosing the problem, organization, and subjects in such a way that--within the framework of the possibilities of the people's economy and in accordance with the available and ongrowing scientists--with sufficient attention being given to basic research, all research plans will aim at the highest possible result coefficient, in the sense of a fruitful widening of our knowledge and a practical application of these insights.

Although the leadership collective of our institute makes great efforts to see that research is left to chance only in exceptional cases, it would be an exaggeration to say that a process functioning completely without friction has already been found for solving all the problems of the organization abd subject matter of our reserach work in the sense of the problem as outlined above. Even with us there are still always differences of opinion on whether our choice of subjects and their results in relation to the practice of fiber production do have an optimal usefulness coefficient. In this respect, it is still an open question on whether the concept of an "optimal usefulness coefficient" can be defined unambiguously today, and it is questionable whether an agreement on this matter can soon be reached between the members of a research institute and the experts of industry. In the extreme case, each understands something different by it--the scientist the final solution of a theoretically interesting basic question, without regard to the time required, and the expert the quick solution of a sometimes very limited partial problem of his manufacturing operation, which will remove in the shortest possible time one of the many headaches in the operation of the enterprise. In my opinion, the main consideration in this respect is to find an organizational form for the connection with practice which assures that all interested parties will be heard in the choice of subjects and which will eliminate the danger that in some partial field we will have basic research without a definite purpose and applied research without an evident reason. These questions of the organizational form chosen in the GDR in the field of research and development were already discussed two years

ago during the first conference on artificial fibers in Moscow, and it was brought out at that time how the "Chemical Fiber" work circle tries to vote between the representatives of the research institute and those of industry on the subjects of research as required by the economic situation and how it tries to make the achieved results useful. The speech is available in printed form in the minutes of the above-mentioned conference.

The work circle, with its work groups as the organization responsible for the choice and voting on the research subjects and the practical application of the results, has proved itself over the past years, and many member of our industry have in this way gained exact knowledge on the development problems of our synthetic fiber industry, while on the other hand the co-workers of industry get to know the work of our institute and can take advantage of it.

During the past year the whole problem, which has been briefly outlined here, has entered a new--one might almost say an acute--stage. Because of the decision of the Fifth Party Congress of the German United Socialist Party, the chemical industry in general and the industry of synthetic fibers in particular have become basic points in the industrial development of the next few years. It goes without saying that these great plans exercise a significant influence on the subject matter and tempo of the research projects of our institute and on collaboration with practice. In an organizational sense, the great "chemistry program" found expression in the formation of research associations. These research associations, which are created individually for a limited period in order to solve a particularly pressing problem, encompass co-workers of different work circles from the basic material to the finished product. To cite an example: the members of the "polyester fibers" research association are representatives of the chemistry of basic materials, the chemistry of synthetic fibers, textile research, and machine-building, from industry and research institutes, who together treat all problems of research and development in the field of polyester fibers, discuss the carrying out of the subjects, and coordinate, control, and discuss the results in order to achieve the highest possible result with the least expenditure of time and money. This circle is consciously kept small and consists of at most 10 to 12 people, who, however, must give assurance that they will lay aside their personal wishes with respect to their research topics in the service of the greater goal of bring-

ing some task of importance for the people's economy from the research or semi-technical development stage into industrial practice as quickly as possible.

Subject Matter

As already mentioned, numerous members of our institute are active within the framework of this organization of scientific and technical research in the field of synthetic fibers, which entails an absolutely necessary constant contact with practical questions. This constant contact gave rise, and does so to an ever-increasing extent, to the choice of subjects for our work, where we let ourselves be guided by the thought that, in spite of all efforts and in spite of all the great successes, there is still in general a very wide discrepancy between empirical experience and scientific insight in the field of synthetic fibers. Thus the primary task of the choice of subjects for a scientific research organization in this field is clearly delineated, since each new theoretical insight will be mirrored with special clarity in an improvement of production conditions brought about by an improved understanding of the basic relations of a work process. The hoped-for close connection with industry and its development organs within the framework of the organization described above keeps the total work of the institute--in spite of and particularly because of the emphasis on its scientific-theoretical work--tied to reality. This is a premise for our efforts to make our organization the central scientific-research institute for synthetic fibers in the German Democratic Republic and thus the scientific conscience of our industry.

Thus, in our choice of subjects, these premises are also important, in addition to political considerations and those concerning the people's economy.

Concerning the people's economy--and thus in a broader sense also political considerations--we may mention the following subjects:

1. According to the decisions of the Fifth Paryy Congress, the bottleneck in the wool sector is to be eliminated as quickly as possible through a consistent development and production of synthetic fibers based on synthetic high polymers and on cellulose, in such a manner that the resulting synthetic fibers when combined with wool or staple rayon, or

in exceptional cases even when used by themselves, will yield clothing with wool-like characteristics of really high quality.

Two basic subjects for our research work follow from the above--namely, the field of polyester fibers and that of polyacrylic nitrile fibers, which we still consider the most promising representatives of the W-type wool-type fibers.

2. The situation existing in the field of viscose cord silk (Viskosecordseide), and to some extent also in the fields of viscose artificial silk and viscose rayon (Viskosekunstseide und Viskosezellwolle), makes it imperative to create the scientific, theoretical, and practical prerequisites needed for the fullest utilization of all the obviously still present possibilities of the raw material cellulose when suitably formed into synthetic fibers. In the end, this means the clarification of the numerous processes of a chemical, physical chemical, and colloid chemical nature which are required for obtaining a regenerated cellulose fiber having the optimal strength, tension, resistance to wetting, curling, and fatigue for the particular application planned. We are fully aware that this subject in particular is more easily stated that solved. As a result, we are also not so conceited as to think that we could solve this problem in all its dimensions and within a reasonable period of time by ourselves--a fact which finds expression in this field particularly through close collaboration with the friendly socialist countries. We try to solve partial problems, to which we shall return later. In any case, this field is also a basic point within out subject matter.

3. In spite of the satisfying development in the field of polyamides, which in the GDR is connected with a certain--one might almost say--tradition, there are also numerous unsolved questions which are reflected in the subjects of our research work. Worthy of mention as examples in this connection are the building up and study of unit-polymer polyamides through systematic synthesis from already known oligomers, the release of the rapid polymerization of caprolactam, and the preparation of melting-resistant products through the rapid polymerization of N-acyl-lactams, discovered almost simultaneously by Wichterle in Prague and by Rothe and Tomaschewski in our institute; further, the preparation and processing of high-molecular polymers with a molecular weight of 100,000 and over, as well as questions relating to the formation of thread from the melt and systematic studies on the preparation of thread under normal and extremely high drawing-off speeds.

Starting with the general assumption that:

a) the size of the molecular weight, the distribution of the molecular weight, the molecular and supermolecular structure, and the chemical behavior of molecular substances;
b) the state of these macromolecules in solution or in the molten state; and
c) the processes during thread formation and orientation and the resulting structure of the thread

determine to a large extent the positive and negative properties of the threads as well as the still existing shortcomings in synthetic fiber production, there then follow further research topics for our institute which correspondingly encompass molecular weight determinations, chain-length distributions, X-ray spectrography, electron microscopy, infrared spectrography, rheology, and microkinematography, as well as kinetic studies on the polymerization and condensation processes in general. Work is also being done on the specific botanic questions of the formation of lignin and cellulose in wood, the careful extraction of cellulose from wood, the reaction ability of celluloses of various origins, as well as unsolved questions on the reaction of cellulose with alkali and carbon disulfide--i.e., on viscose formation.

In conclusion, let it be mentioned that modern analytical methods for the characterization of starting materials and intermediate products of synthetic fiber production are also being worked out, and new refining and testing procedures for synthetic fibers are being developed and studied.

The Relation of the Results to Practice

As was developed above, it is our main aim insofar as possible to connect our work, even those aspects having a decidedly theoretical subject matter, with some tasks set by practice.

In the last part of this exposition an attempt is made to show, on the basis of some examples of results obtained last year and this year, to what extent it was possible to reach this goal. At the same time this shows how we conceived this relation of our work to practice and what we understand by it. It will be seen--and this is why we reproduce these three examples--that here, without doubt, is cause of discussion and criticism. We are also aware of the fact that we will

still need much effort and undoubtedly also time in order to achieve the connection to practice in the sense of being able to solve acute problems and on the other hand simultaneously to work out insights for new technical development possibilities which will lead to improved industrial processes only in the future or may even lay the foundations for the preparation of new types of fibers.

The first example concerns the results of studies in the field of viscose synthetic fibers.

It is well known that to date relatively little information is available on the unquestionably very important process of the coagulation and regneration of viscose solutions--i.e., on the unfolding of the process of thread formation in the spinning bath. The reaction taking place in this case, which runs its couse in a fraction of a second and is a combination of diffusion processes, osmosis, and chemical reactions, has a rather far-reaching influence in determining the behavior, quality, and physical properties of the finished regenerated cellulose threads. Thus the experimental clarification of these processes and their theoretical interpretation are matters of great practical interest.

So far we have used and developed two methods for approaching the final solution of this problem.

1) the microphotographic recording of spinning individual threads, under technological conditions;
2) the study of cellulose xanthogenate model threads

In addition, we are at the moment working out new methods to determine the rate of coagulation of viscose solutions depending on the type and concentration of the solution used. The following results--here summarized briefly--are available to date:

With the help of the microphotographic method it is possible--with the assistance of indicators--to characterize completely the neutralization and acidification processes in the spinning bath and to determine in what manner the entry of hydrogen ions into the cellulose xanthogenate gel depends on the composition of the viscose and of the bath as well as on the output and the rate of drainage. Through this method it is also possible to determine the effect of so-called modifiers.

For example, we found very interesting relationships between the manner in which the regneration process takes place, and the proportion of the salt concentration--especially Na_2SO_4 and $ZnSO_4$. The retarding effect of the modifiers on the decomposition, already known per se, as well as their effect on the amount of swelling of the gel, can be measured exactly and determined numerically. This makes it possible to characterize the mode of operation of different modifiers. We were also able to demonstrate that the modifiers have a decided effect as protective colloids.

The studies on model threads led, among other results, to a clarification of the connection between the action of the $ZnSO_4$ present in the bath and the formation of the coating and nucleus in viscose threads. We further found that the course of the decomposition of the zinc xanthogenate is strongly dependent on the fluctuation of the nydrogen ions diffusing in and the hydroxide ions diffusing out. All these determinations led us to a conception of the course of the decomposition in the spinning thread which in the end culminates in a situation where strongly acid to strongly basic layers in the interior of the thread appear and are passed through, with the reactions which are decisive for the structure of the thread taking place at the carefully studied border layer between acid and alkali, while at the same time an important role is played by the diffusion speed of the bath components, which in turn is influenced by the composition of the bath and of the viscose.

We are of the opinion that the final clearing up of the relations sketched here is of considerable importance for the practice of viscose spinning and that this is the only way in which empiricism--for example, in trying out new spinning schemes--can be overcome.

The second example concerns the results of studies in the field of polyester fibers.

In this case, the problems of greatest urgency for us at the moment are the search for a suitable catalyst for the interchange of ester radicals and for polyester formation, and the important as well as difficult question of improving the fusing stability of molten polyethylene glycol terephthalate. A systematic study was carried out on the first problem The results showed, among other things, that forumlating the question as above is incorrect--i.e., the mode of operation of the catalysts changes according to whether they

are used for the interchange of ester radicals or for the formation of polyesters. Thus, cobalt acetate, for example, is more effective in the condensation than in the pre-condensation. It further turned out that the most effective catalysts (for example, iron benzoate) unfortunately cannot be used in practice because of the discoloration which always takes place, especially since the resulting polycondensates were also very unstable thermically. We were also able to determine within the framework of these studies that the exchange of ester radicals as well as polyester formation occur as first-order reactions. As a practical result, it was seen that there are probably no optimal catalysts in the sense in which the question was posed, so that, unfortunately, for the time being compromises must be made which take into consideration the rate of ester radical exchange and of polycondensation, as well as the color tone and thermic stability of the melt.

Our results available to date regarding the improvement of thermic stability showed a relation between the thermic stability of a polyester and the number of free carboxyl end groups in the condensate. If this determination is confirmed, we will at least have an indication of how to attack this extremely difficult problem. There should be no question that even a partial solution would already be of extraordinary importance for practice.

The last example is chosen from our studies in the field of polyacrylonitrile fibers.

As may be seen from the publications by our institute, the systematic studies conducted by us were the basis for the adoption of the so-called Prelana process in the Friedrich Engels VEB Articifical Silk Plant of Premnitz. These studies encompassed the development of a reduction-oxidation-polymerization process for acrylonitrile in solution and the spinning in hexanetriol baths of the polymerizate dissolved in dimethyl formamide. A continuation of these studies has lately led to the development of a continuous polymerization process--i.e., to the preparation of the spinning solution in one operation from acrylonitrile in dimethyl formamide. It should be obvious that such a process, when transferred to an industrial scale, has considerable practical advantages in comparison with the discontinuous process being used at present, in which the polymerized acrylonitrile is first isolated, crushed, and dried, and then dissolved in dimethyl formamide to give the spinning solution. Naturally, many

problems always develop in working out such a process, and in this case they are, for example, the question of the duration of polymerization, the size of the exchange, and the setting of the molecular weight appropriate for spinning. In order not to be dependent on purely empirical experiences in this work, in the past year we have carried out some kinetic studies on the catalytically initiated polymerization of acrylonitrile in dimethyl formamide, ethylene carbonate, and other solvents; the mathematical interpretation of the results showed, among other things, that although the rate of reaction in ethylene carbonate is greater than in dimethyl formamide, this causes the ethylene carbonate solution always to result in polymers of a considerably higher molecular weight than the dimethyl formamide solution, and according to experience the working of such polymers into fibers presents more difficulties. These mathematical interpretations of the kinetic studies therefore led us to the practical result that dimethyl formamide has certain advantages over other solvents as the solvent for the continuous polymerization of acrylonitrile, in spite of the relatively small rate of growth.

Ig seems necessary in conclusion to point to one more fact, the importance of which cannot be overestimated and which also in one sense represents an important relation to practice. This is the training of young chemists in our specialty. This task is also being tackled by our institute at a steadily increasing rate through the issuing of diplomas and doctorates and the placing of these graduates in the synthetic fiber industry.

For this reason let it be emphasized at this point that quite a number of our young collaborators, some trained by us, have had a prominent share in obtaining the results of some of the studies which were described in more detail as well as of other studies made at our institute which were not touched upon in this article.

EAST GERMANY

Cooperation of the Chamber of Technology in Carrying Out the Chemical Program

[This is a translation of an article by Heinz Marten in Chemische Technik, Vol 11, No 9, September 1959, Berlin, pages 516-517; CSO: 3276-N/6]

Through its valuable collaboration in building up our socialist people's economy, the KDT [Kammer der Technik; Chamber of Technology] gained general recognition, so that it became more and more an integrating element of the economic life of the German Democratic Republic. While the First Congress had the task of organizing the work of the KDT in the direction of the achievements reached up to that point, during the Second Congress the purpose was to orient the voluntary technical collection work in accordance with the great economic development of the German Democratic Republic. While until the Second Congress in January 1959 the KDT saw its main task in the dissemination of knowledge for the advancement of technical education, this is no longer sufficient.

While the institution of meetings having international participation gave the different technical fields a good orientation on the newest stand of technology and impulses for further activity, especially among the technical groups and enterprise sections of the KDT, they yet did not lead to results which represented an immediate advantage for the enterprises. In some cases the state organs received recommendations and important suggestions for further development in the various branches of the economy. Thus, for example, the FV [Fach Verein; Technical Association] "Chemical Technology" participated in the development of synthetics and layer plastics and contributed decisively to the popularization of an appropriate use of these substances. The development of tires, coatings, and modern laboratry equipment, and their introduction in the laboratory and industrially, as well as recommendations for the law on the protection of wood and for the law on the admissible quantity of waste matter ejected by industrial chimneys are a few other results of the activities of the FV.

Today the 80,000 members of the KDT request that they be allowed to participate actively in the shaping of the technical-economic problems of our people's economy. Such a concentration of technical experts, who have voluntarily joined together for the furthering of the technical-economic progress and the fulfillment of the socialist reconstruction of the GDR, represents a great potential achievement for our people's economy. In West Germany there is also an engineering organization, the VDI [Verien Deutscher Ingenieure; Association of German Engineers]. It is undeniable that thousands of members of the Association of German Engineers deserve great credit with regard to the development and progress of technology in Germany. Unfortunately, however, it is also a fact--and this was proved on the occasion of the Second Congress of the KDT--that many members of the VDI were "misused" for anti-national and anti-democratic purposes by the management directed by the concerns, and the results of their work were used for rearming and for the imperialist war. It was shown by information in the VDI Nachrichten that the VDI has today again become an instrument of the monopolies and is being used to prepare for war.

Because of this, the KDT has the responsibility of enlightening all scientists and engineers about these matters, so that they will be able to fulfill their tasks while being fully conscious of the political connection. The completion of socialist construction requires highly trained workers, engineers, and scientists, who are convinced of the victory of socialism, who make good use of the advantages of socialist cooperative work, and are guided in their thoughts and actions by the spirit of true humanism, the basic principles of socialist morality.

For the KDT it is now time to develop and promote a higher form of voluntary-technical collective work--namely, socialist collective work, with particular emphasis on collective work on complex tasks. This is particularly the case where the KDT cooperates with the chemical program, the nucleus of the solution of the main economic task. Socialist work collectives have already developed in many enterprises, and in addition in many bezirka inter-enterprise collectives have been formed.

In Halle Bezirk, for example, a socialist work collective was formed on the intiative of the enterprise section of the Wolfen VEB Dye Plant (Farbenfabrik) from co-workers of the

Wolfen VEB Dye Plant, the Agfa Wolfen VEB Film Plant (Filmfabrik), and the Bitterfeld VEB Electrochemical Combine; it works on complex problems such as how and where the accumulating pit water from the open working of brown coal may be usefully utilized, how the artificial forwarding of the waste water from the "Johannes" pit can be made to occur naturally beyond the drainage pit, in what manner different materials to counter the corrosion of the ventilator wings on ventilator cooler towers should be introduced, etc.

In Karl Marx Stadt, Erfurt, and Leipzig Bezirks, socialist work collectives called "Chemical Program" were formed and set themselves the task of bringing together the technical leadership of the available FV's for the solution of complex problems.

In Leipzig, for example, the following problems are being treated: further uses of synthetics, recuperation of phenol, and biological purification of the Leipzig waters, consultations on the design of chemical installations, problems of petroleum chemistry in connection with the development of the Schwedt (Oder) Petroleum Combine.

A decision of the "Chemical Technology" FV on the occasion of its second session of delegates in May 1959 states: "In order to give effective support in their people's economic tasks to the enterprises of the chemical industry of the GDR through socialist collective work within the framework of the KDT and guided according to the plan, the development of the "Chemical Technology" FV and the activation of its inter-enterprise groups, as well as of the enterprise sections, is to be continued and reinforced with all available means. In order to raise the degree of effectiveness of the enterprise sections and support their technical activity, all central and district (bezirkliche) leadership and work groups of the FV are to shape their entire activity in a manner more closely connected with practice. It is required that the enterprise sections delegate more co-workers for the central and district work groups. In this connection, young scientists, technicians, and economists are above all to be given the opportunity to work with older colleagues in their field on the solution of problems of the people's economy in the management and work groups of the FV." The need for an improved leadership in the FV was satisfied through a new election of the leaders. Interpreting the consumltation of the economic commission of the Politbureau at the ZK [not identified] of the United German Socialist Party with KDT functionaries, the

new leadership of the technical association, "Chemical Technology," gave advice on the further tasks and in particular on the concrete collaboration of the KDT in the chemical program. The most insistent complex problems in connection with the fulfillment of the chemical program combine the goals of obtaining an optimal performance of machine-building and the construction industry. This is the basis for the technical-economic problems which the KDT has set itself now that it will participate actively in the fulfillment of the chemical program under the guidance of the "Chemical Technology" FV. In the future it will not be possible to consider separately from the work of the KDT such important problems as the design and construction of new installations and the technological shaping of individual procedures, or the far-reaching type-clarification and standardization of the equipment needed by the chemical industry and of the products made by it. In order to avoid a scattering of the available forces and duplications of work, the technical committees with the corresponding VVB on the one hand, and the technical leadership in the districts with the economic agencies on the other hand, are setting up systematic communications and concluding agreements. Regular reports and exchanges of experiences on the occasion of the planned quarterly enlarged leadership meetings are expected to lead to concrete guidance activity within the FV. The further events still planned for 1959 by the FV "Chemical Technology" are supposed to present complex problems to a wider circle of co-workers and to lead them toward concrete tasks, to the immediate advantage of the enterprises. Simultaneously, further training of the workers in close correlation with the practical tasks at hand is to take place. An important measn for the realization of the chemical program is represented by inventions and suggestions, and especially by the engineer account movement. It can be shown that, in accordance with the orientation of the enterprise sections of the KDT toward this particular possibility, there resulted an absolute and relative increase in the engineer account movement in the large chemical enterprises.

Comparison of the Engineer Account Movement in Halle Bezirk, First Quarter of 1958 Compared to First Quarter of 1959

Quarter	Number of Engineer Accounts: All Industrial Branches	Number of Engineer Accounts: Chemical Enterprises	Profit for the People's Economy: All Industrial Branches TDM*	Profit for the People's Economy: Chemical Enterprises TDM
I (1958)	81	11	941.6	787.0
I (1959)	130	61	1,433.4	1,094.4

*[Presumably; 1,000 DM]

The popularization of the work of the KDT will demonstrate to the whole population the significance of voluntary technical collective work for the building of socialism in the GDR. For this reason it is most necessary to pay the greatest possible attention to the popularization of the results achieved, since recommendations, suggestions, etc. fulfill their purpose only if they become known to those who can see that they are realized. Also, but not least, the publicity carried out by the KDT should contribute to making all employees aware of the long-range aspects of technology in a socialist society and thus to making them better able to use all their powers on the side of progress, for the good of all the citizens of our state and of the whole peace camp.

1024

EAST GERMAN

Tasks of East German Steel and Rolling Mills in Support of the Chemical Industry Program

[This is a translation of an article by Rolf Schroeder in Neue Huette, Vol IV, No 9, October 1959, Berlin, pages 578-584; CSO: 3222-N/a]

The following statements describe the results of the work of a departmental committee concerning ferrous metallurgy, with the goal of particularly directing the attention of members of the metallurgical brancy of industry to vital questions of the chemical and refined steel industry programs.

* * *

The reconstruction plans worked out at the present time should set aside former divisions resulting from the capitalist inheritance and replace them with a concentration and specialization of products corresponding to our socialist production conditions. The reconstruction concerns at the same time the following concepts:

1. Renovation, adaptation, and modernization of the present production facilities to correspond to current standards of technique.

2. Organizational and technical measures designed to increase efficiency and production.

3. Introduction of the newest techniques.

4. Standardization and classification of products in order to increase production by reducing the choice of types.

The reconstruction may be undertaken step by step with full economic success by considering not any one specific enterprise but rather a particular production branch in its entirety. The establ shment of a corresponding time schedule therefore necessitates an agreement between the supplying and consuming branches of industry, and thus involves complex planning.

2. Previous Work Methods of the Steel Industry

The tendency of metallurgy to place greater value on quantity than on quality and variety has inhibited its further development. This was particularly pointed out in the criticism of Walter Ulbricht on the occasion of the Fifth Party Day (V Parteitag). The steel industry of our country must therefore pass over into the third stage of development and accelerate its production of quality and refined steel. The small amount of mass steel (Massenstahl) decreased thereby should be replenished through importation, which requires considerably less expenditure than does refined steel.

The lack of cooperation between developmental sites in the steel-consuming industry and ferrous metallurgy has led to difficulties, since the development of the necessary steel types was begun only at the moment that the consuming industry approached metallurgy with its demands. At this time, however, the designing and/or construction of apparatuses and the planning of machines was already so far advanced that there was not sufficient time for the development of new steel types. Unwelcome delays occurred, forcing utilization of the required quality refined steel for the first apparatuses and designs, since the carrying out of the plans could not be held up. For this reason it was emphatically demanded at the Fifth Party Day, as well as the Chemists' Conference, that in the future metallurgy have at its disposal sufficient time for development.

Simultaneously, however, at its commencement, the production of refined steel with its involved procedures--as a result of the previous overemphasis on the production of mass steel--must be broken. Refined steel can be produced only with particular care, following proven techniques, by the use of corresponding factories, and by capable and conscientious experts. Furthermore, its purity must ensured by repeated controls during fabrication and through analysis before shipment.

3. New Work Methods of the Steel Industry

The previous work methods of the steel industry, censured at the Fifth Party Day as "ideology by tons" must be changed and improved as quickly as possible.

The dimensions of the proposed task no longer permit a single person or institution to consider these problems alone, but rather demand genuine collective work.

For the realization of the chemical industry program, it is therefore necessary that chemists, engineers, and metallurgists agree among themselves subjectively and regularly concerning their developmental problems. Collective work must, however, not be limited to chemists, engineers, and metallurgists. The problems imposed upon these particular branches of industry are too great to be soluble without collective division of labor. No one personality and no service department has today the ability to overcome alone the dimensions of the work to be accomplished. This fact has been recognized by the Iron Trades Division of Mining and Metallurgy of the State Planning Commission (Fachgebiet Eisen der Abteilung Berg-und Huettenwesen der Staatlichen Plankommission). A short time after the publication of the chemical program, a group of experts took upon themselves the task of determining the investments to be made. It also decided research and standardization, improvements in the area of TKO [presumably, Technical Control] work in testing materials, as well as their personnel development.

4. Steels of the Chemical Industry Program

This group suggested more than 60 steels for the chemical industry program. They may be classified in the following five groups:

Group 1:

Twenty-one rust-free and acid-resistant steels, of which 10 are ferritic and eleven are austenitic.

This group does not include steels for welding electrodes, which are required for welding steels of this group. The recommended austenitic steels are almost all from the basic type 18 chromium/8 nickel (similar to V2A [not identified]), with the addition of molybdenum for inhibition of corrosion holes and with niobium-tantalum or titanium for the prevention of intercrystalline corrosion specifically between molybdenum and tantalum. The ferritic steels are considered as chromium steels and are melted with or without molybdenum according to the requirements.

Group 2:

Fifteen steels stable under hydrogen pressure: this group contains only ferritic steels which are built upon a chromium or chromium-molybdenum basis.

Group 3:

Ten steels remaining solid when heated for use at temperatures of 350 degrees centigrade.

Of these, two are austenitic chromium nickel steels, five are ferritic chromium-molybdenum steels with and without addition of vanadium, and three are ferritic manganese steels.

Group 4:

Eleven heat- and flame-resistant steels. Of these, four belong to the chromium-aluminum type, three to the chromium-silicon type, and the remaining four are chromium-nickel-silicon steels.

Group 5:

Nitrated, enchromed (inchromiert) and aluminized steels. Besides two chromium-molybdenum-vanadium steels and the chromium-titanium alloyed enchromed steels, the unalloyed steels CK10 and CK15 are included here.

Furthermore, the production of plated pipes and sheet metal is contemplated. In the GDR there is little experience concerning these.

5. Refined Steel Program

Besides the preparation of steels for the chemical industry program, it was also decided on the occasion of the Fifth Party Day to increase the variety of refined steels as well as its dimensions. Since steels intended for the chemical industry program comprise the greatest part of the refined steel program, it was decided to enlarge its assortment correspondingly. The previously mentioned five steel groups were thereofre complemented, to be augmented by four more groups:

1. Alloyed construction steel
2. Machine-tool steels
3. High-speed tool steels
4. Special steels

The last group includes steels for rolling mills, turbine blades, valves, springs, and solid joints.

As was mentioned at the beginning, the production of refined steel requires a considerable revision of the former methods of work. In particular, the present facilities must be supplemented or replaced, as for example, the improvement of foundry facilities and especially installations for refractory stones as well as preparation of heatable refrigeration chambers. Although raw materials for the preparation of better refractory stones are not available, it is necessary to test whether by the corresponding importation of raw materials it is possible to bring our own production to the urgently required quality.

In the steel mills, the ingot treatment capacity and in some cases also the resulting annealing capacity must be supplemented, since in a number of steel types it is necessary to soften the blocks before treatment.

In the rolling mills particular attention must be given to cleaning and pickling levers, to polishing and scaling steel rods, as well as to the necessary facilities for annealing, compensating, standard annealing, and starting.

The completion and removal controls for refined steel may be improved by facilities for surface analysis.

Still to be mentioned are the annealing of certain steels under protective gas for the removal of carbon, as for example, steel for rolling mills or for filing, and the rough preliminary polishing of steel rods. Both these procedures must soon be introduced according to the latest advances in technique.

Part of the previous imports is a relative small amount of steel with special characteristics which requires a long time for delivery in the GDR or is at this time completely rejected by the rolling mills. A compromise must be found here between enlarging the corresponding rolling mill equipment and the economical production of steel with these characteristics.

Extrusion should be mentioned as a second solution, as it is particularly suited for the economic production of relatively small amounts of steel having specific characteristics.

As is known, the building of the steel industry has not been completed. This causes about 80 percent of these products to be imported in the second stage of treatment. Since at the same time this branch of production is especially rewarding, it must be particularly advanced in the future. One must consider, however, that raw material must be available in sufficient quantity and quality.

Investigations by specialists have given a clear picture of the present situation in our steel industry. Four points urgently require promotion:

1. The production of seamless pipes
2. The production of sheet metal from highly alloyed steels
3. The second intermediate stage of treatment
4. The production of plated materials

The refined steel program is especially concerned with introducing into current production those steels already known but not yet made within the GDR. For example, in Group 1 the number of rust-free steels must be increased to 21 types.

Considered from the point of view of melting technique, eleven of the suggested steels in this group are currently being melted. The production of five more steels creates no difficulties and can be started at any time. In five steels the carbon content is less than 0.10 percent. Smelting is considered, since according to experiences of the Iron Research Institute (Eisen-Forschungsinstitut), only a carbon content of not less than 0.12 percent can at the present time be accurately determined by the use of the electric arc furnace. These steels must therefore be prepared in high-frequency ovens.

There is still developmental work to be done on three steels:

X 5 Cr Ni Mo Cu Nb 18.15, with 0.05 percent C, 18 percent Cr, and 15 percent Ni, plus 2 percent Cu
X 12 Cr Ni Si 36.16, with 0.12 percent C, 36 percent Ni, and 16 percent Cr plus 2 percent Si
X 12 Mn Cr 18.12, with 0.12 percent C, 18 percent Mn, and 12 percent Cr

The difficulties with the first-mentioned steels are concerned again with the carbon content. A steel stable to sulfuric acid cannot, at the present time, be replaced by another alloy combination.

In the second steel, the high nickel content of 36 percent causes difficulties, since a hydrogen-poor nickel metal corresponding to lunar nickel as an alloy additive can be reduced. The high hydrogen content of all other nickel types makes alloys having more than 30 percent nickel less malleable or unmalleable. If the previously encouraging experiments of the Iron Research Institute in attempting to melt this steel by another process should not prove successful, then production may be considered only by means of a vacuum induction furnace.

For the third steel there is at the present time an insufficient amount of manganese metal available. This has been obtained by means of electrolysis or distillation. The previously delivered manganese metal (produced alumino-thermically) contains large amounts of silicon and aluminum. Thus, the production of this steel with an austenitic structure without the occurrence of δ-ferrite is questionable.

Of Group 2, nine steels stable against hydrogen pressure are currently being melted. For six more, the melting techniques are already known, so that their production would not cause any difficulty.

Of the third group, the ten steels remaining solid when heated and usable at temperatures of over 350 degrees centigrade are already currently being melted.

Of those in the fourth group comprising eleven heat- and scale-proof stable steels, four steels of the chromium-aluminum type and three steels of the chromium-silicon type are already being melted. Of the chromium-nickel-silicon steels, three present no difficulties in their melting techniques. Although only rarely, these are already being melted. The one remaining steel type (36 percent nickel) must, however, be further developed, since its production in large units, as is currently done, still creates difficulties in the electric arc furnace.

Of the nitrated, enchromed aluminized steels of the last group, five are currently being delivered.

Although our steel workers are able to melt every steel having a chromium content of less than 20 percent, a nickel content of less than 15 percent, and a carbon content of less than 0.12 percent, with the lack of auxiliary facilities the rolling mills are in arrears.

Of the refined steel program is to do without imports, the production must be increased the following amounts per year (in tons):

Alloyed construction steels	26,400
Steels remaining solid when heated	750
Specialized steels	17,800
Machine-tool steels	8,600
High-speed tool steels	3,150

In the production of the second stage of treatment, the increase per year must be as follows (in tons):

Alloyed pipes	29,340
Alloyed cold-rolled products	2,550
Alloyed drawing installation products	8,970
Drawn spring steel	22,440

In summary, the total amount of refined steel must be increased until 1965 by 306,000 tons. This means an increase of about 230 percent in six years. This assumes a great deal of construction, renovation, and adaptation of the steel and rolling mills.

In all, 440,000 tons of electric furnace steel and 1,550,000 tons of Siemens-Martin steel are required. According to the projected plans, by 1965 an increase to 290,000 tons in the capacity of electric furnace steel is foreseen.

This necessitates an additional capacity of 150,000 tons through the setting up of two 35-ton arc furnaces with 90,000 tons, three 18-ton arc furnaces with 50,000 tons, as well as one 5-ton arc furnace. Correspondingly, the rolling and drawing papacities must be enlarged and/or rebuilt.

6. Construction of Steel and Rolling Mills for the Fulfillment of the Refined Steel Program

For the individual mills, the following changes are contemplated:

6.1 VEB "8 May 1945" Refined Steel Mill in Freital

In this steel mill two 18-ton arc furnaces must be erected for a yearly increase of 50,000 tons of electric furnace steel by 1964.

Recent experiences in the melting of aeronautical steel and turbine blade steel, however, make the erection of 18-ton furnaces seem purposeless, since the course of melting in furnaces of this size is not yet fully controlled, as is necessary for the production of valuable steels with the desired high degree of purity from slag.

Generally, in such cases there is a corresponding choice in the charge. This possibility is not given in the GDR since the quota requiring steels with a high degree of purity is very high. For this purpose, therefore, four 10-ton furnaces should be created.

For steels composed of large amounts of alloyed components, in particular of chromium, nickel, and manganese, as well as an extremely low carbon content, a vacuum melting pot is required. Three furnaces (250 kilograms and two at 500 kilograms) are planned. These should have a capacity of 1,000 tons per year.

Valuable steels, in first line for the chemical industry program, require 25-ton vacuum casting facilities. The extensive freedom from gases of steels poured under vacuum reduces the tendency to flake or at least decreases the period of flake-free handling by about 70 percent. According to references in the literature, the castability and the purity from slag are also improved. This must still be verified.

If the refined steel program is to reach its fullest potential in this steel mill, it will be necessary that the continuous casting process also be fully instituted. Therefore, a corresponding arrangement with casting weights of 25 tons must be built and utilized.

For the milling of round bars with diameters from 65 to 120 millimeters and of semifinished products, especially with platinum, a three-armed 600 type of breaking-down mill is planned. This must go into utilization by 1963, as otherwise by 1965 there will be no available starting materials for the production of refined steel sheets less than 6 millimeters in thickness. This assumes that the Burg Rolling

will undertake the production of this material as planned.

By 1961 the 280 type of rolling train for light sections must also be utilized, thus increasing the capacity of five round bars to 70,000 tons per year.

For the production of forgings from alloyed steel, an additional 2,000-ton and another 700-ton press are planned. These should be working by 1961 and 1964 respectively and should deliver 7,000 tons per year.

The annealing installation and the tempering facilities in Freital have not as yet met the demands which must be placed upon refined steel mills. Enlargement of the annealing and tempering capacities to 100,000 tons per year, originally planned for 1961 to 1963, must be partially advanced.

Heatable cooling chambers such as were erected in the Maxhuette at the behest of the Iron Research Institute, which have proved most valuable, are practically nonexistent in Freital. They are, however, necessary for a refined steel mill. Therefore, the construction of 11 heated cooling chambers must be accelerated.

Regulation and shipment have been seriously neglected at all rolling mills. Valuable steels must be delivered unmistakable designated and packed. Thus the regulation and shipment facilities in the refined steels must be made consistent with the latest developments in technique by 1965.

6.2 VEB Steel and Rolling Mill at Groeditz

Besides the Refined Steel Mill in Freital, the second main support for the refined steel program is the Groeditz Steel and Rolling Mill, which again should specialize in forging products. Also here an enlargement must be made in the melting capacity of the electric furnace steel in order to utilize the services of the 6,000-ton press for 60-ton forging blocks. However, because of the very extensive investment required for a new steel mill, this has been postponed. Only an additional 18-ton electric arc furnace is being construction in Steel Mill No 2.

This author suggests that 60-ton forging blocks be poured from the two 35-ton arc furnaces planned for Riesa. These

would be transported the short distance of about 20 kilometers to Groeditz by means of a special car belonging to the Reichsbahn and having a carrying capacity of 90 tons. This car would have to be converted into a heated car. At Groeditz the forging blocks would be forged by the 6,000-ton press. This, of course, assumes a reinforcement of the crane facilities available there.

The large forge itself should be enlarged by a 3,000-ton and a 1,000-ton press as well as by a 3,000-kilogram hammer. It would then be abbe to manufacture 32,000 tons of forgings from refined steel as well as 42,000 tons of forgings from quality steel. Before everything else, however, the facilities for tempering and flake-free annealing must be enlarged. Besides that, in the future Groeditz should produce pipes and special sections from highly alloyed steels according to the flow press (Fliesspresse [assembly-line press?]) procedure. The previous manufacturing capacity should be greatly increased so that the largest forgings producible in Groeditz--that is, up to 11.5 meters in length and 4 meters in diameter--may be handled.

Equipment for analysis is insufficient and will therefore be supplemented. Especially lacking is a warm circulating arm for making tests for turbine rotors and induction waves. Thus in the future finished parts may be deliverable with certified analyses made from a warm circulating arm in accordance with demands of the machine-building industry.

6.3 VEB Steel and Rolling Mill at Riesa

The enlargement of the steel and rolling mills at Riesa is considered the third main prop for the refined steel program. The main task would be the production of weakly to highly alloyed pipes.

Besides the already mentioned erection of two 35-ton electric arc furnaces for increasing the melting capacity for electric steel, in 1963 Riesa should also operate a continuous casting installation having a capacity of 200,000 tons per year.

If the suggestion of this author concerning the 60-ton forging blocks for Groeditz is realized, then a vacuum melting installation for 60 tons would also be constructed in Riesa. However, this measure must still be thoroughly dis-

cussed since the previous advantages of pouring under vacuum--that is: 1) practically no oxidation of the pouring stream; 2) decrease of the hydrogen content--seem to have been basically exceeded by experiences in the meantime at Groeditz. Specifically, following the suggestion of K. Lehmann (VEB Chemical Works at Buna) and of P. Holtzhaussen and H. Fiedler, the pouring of steel under nitrogen as a protecting gas layer by sicromal smelting (Sicromalschmelzen) has been successfully introduced in Groeditz. A thorough investigation would show to what extent pouring under protective gas is able to decrease oxygen occlusion and/or the oxygen content.

In Groedtiz in the meantime the isothermal flake-free annealing developed by Ed. Maurer was introduced in 1956-1957 by his colleague, L. Kolar. It was tested by S. Kronmarck in 1958 and yielded positive results. Nowadays the formation of flakes in large forgings is avoided to a large extent.

The rolling capacity of the mill in Riesa will be increased by the 700 type of breaking-down mill train having two arms. After 1962 each year it should mill 370 tons of round material having a diameter of 90 to 160 millimeters. This would serve as starting material for tube rolling mills.

The increasing need for seamless pipes of alloyed steel shall be covered by the construction of a Stiefel mill train with 60,000 tons per year. Simultaneously, the capacity of the cold-rolling Pilgrim mill facilities would be increased to 5,000 tons per year.

By 1963 the capacity of precision steel-drawing works for seamless pipes would reach 40,000 tons per year. Assumed for the necessary quality of the pipes is the construction of facilities for quality control.

6.4 VEB "Wilhelm Florin" Steel and Rolling Mills in Hennigsdorf

The "Wilhelm Florin" Steel and Rolling Mill must also be considered in the refined steel program. By 1962, the existing 450 type and continuous rolling train must be supplemented corresponding to a work increase of 30,000 tons per year. Furthermore, a round bar drawing and scaling installation is being constructed for a yearly capacity of 35,000 tons of drawn and 35,000 tons of scaled bar steel. The steel mill shall specialize in reinforced concrete steel cables. There-

fore an oil-type final tempering installation with an annual capacity of 30,000 tons of oval and 10,000 tons of round wires is being built.

For wires with more than 100 kp [not identified] per square millimeter, Hennigsdorf has a drawing installation with an annual capacity of 50,000 tons.

In order to eliminate the insufficient bundle weights in cable wire and to reach the latest levels of technique, a continuous rod mill is planned to provide annually 300,000 tons of wire measuring from 5 to 18.5 millimeters in diameter and having a tolerance of ± 0.15 millimeters, as well as bundle weights of approximately 400 kilograms.

The present block handling and heat capacity in Hennigsdorf no longer suffices for the increased demands and must be modernized as well as enlarged.

6.5 Consolidation of the Sheet-Metal Producing Mills

The suggestion that refined steel sheets with diameters of less than 6 millimeters be rolled in the VEB Rolling Mill in Burg and all other sheets with a diameter greater than 6 millimeters be rolled in the VEB Rolling Mill in Hettstedt is in contrast to a project for the VEB J. W. Stalin Iron Works Combine in Stalinstadt. Here an electric furnace and a Sendzimir rolling mill are to be erected.

Against the second suggestion, particularly against the construction of a 60-ton electric furnace, there is considerable concern on the part of the Iron Research Institute since, at the present time, it is still difficult to specify the required degree of purity in the melting of aeronautic and turbine blade steels in an 18-ton electric furnace. Only after completely controlling the 18-ton and ajunctively the 35-ton furnace could one go over to a 60-ton furnace for preparing refined steels having the degree of purity demanded in the GDR. However, there is nothing to be said against this furnace for the manufacture of texture strips (Texturband) and/or transformer and dynamo sheet metal.

6.6 Work on the Second Stage of Manufacture

For the construction for the second stage of manufacture, Finow will receive a cold-rolling mill capable of delivering 30,000 tons of cold-rolled strips in 1962. To this will be joined a tube cold-drawing installation for 20,000 tons of precision pipes per year. It will receive its material from a projected pipe welding plant with a capacity of 30,000 tons per year of precision and construction pipes from 15 to 60 millimeters in diameter. As starting material, this mill rolls a 500-millimeter wide hot-rolled strip in the amount of 200,000 tons per year with a bundle weight of 600 kilograms. A corresponding pickling plant is planned.

Furthermore, Finow has a profile rolling mill which will produce 8,000 tons of profile steel in 1961. Its facilities are being correspondingly increased.

The remaining cold-rolling mills, such as the round bar rolling mill of Lugau, the pipe-welding workshop of Karl Marx Stadtm as well as the strip cold-rolling mills of Oranienburg, Salzungen, and Leipzig are also being enlarged, supplemented, and reconstructed in order to meet the increased demands in quality and quantity.

The Iron Works Combine of Stalinstadt contains four 50-ton inflation converters. Additionally, there are a cold-rolling mill and a pipe-welding installation for gas pipes. Furthermore, the Iron Works Combine at Stalinstadt should contain a roll train for texture strips.

For the sake of brevity, this report mentions only the main projects. Auxiliary facilities planned are, for example, the necessary annealing facilities, processing machines, and devices for adjustment and shipment. In the preparation of this program, apparanetly subsidiary subjects were also considered since lack of regard for them was also a reason why, in spite of large investments in it, the metallurgical industry delivered material partially unfinished. Thus, for example, the Refined Steel Mill at Freital, as previously mentioned, lacks heatable cooling chambers for letting down block and sufficient furnaces for annealing calcium- and ferro-alloys.

7. Research and Developmental Tasks in the Refined Steel Program

The fulfillment of the chemical program faces not only the production of revolving measures and adaptations but also research and development of a wide range of problems which evolve from the refined steel program and its setting up of quality.

To be mentioned particularly is the melting under vacuum of highly alloyed steels, whereby the main attention must be directed to the development of apparatuses for vacuum induction and arc furnaces with insertions of up to 5 tons. This problem can only be solved by collective work between metallurgical and technological institutes having special usage of machine building.

With several highly alloyed steels, smelting under vacuum does not appear mandatory, although perhaps it is necessary for casting. This will presently be clarified in Freital by a casting weight of 25 tons. The above-mentioned collective group is to be useful here too.

The fulfillment of the refined steel program requires the three-layered utilization of the multiple continuous casting facilities erected in Freital. At the present time comparative investigations of blocks poured in the usual manner as well as of strands produced by continuous casting facilities are being conducted. The results still remain to be publicized.

Since it has not previously been finished in the GDR, the production of plated sheets from refined steel for chemical plants is to be considered here. Besides this, plated pipes are also necessary. The Iron Research Institute considers it purposeful that the chemical industry first be offered an assortment of welded, corrosion-resistant pipes of all possible measurements before the production of plated pipes in instituted.

The production of thick-walled containers plated on the inside is economically ensured and should therefore be started.

The direction of development in the construction of machines is aimed at saving weight and therefore demands special characteristics in steel. By all means, developmental work should be encouraged which concerns prerolled material for profile cutters and hot-rolled light construction profiles.

8. Personnel Development

To carry out the designated projects, approximately an additional 60 university engineers and 250 trade school engineers will be required by 1964. The main professional attention will be on the study of resilience. In the second place, steel working engineers are required for the mills. This number does not include, however, the requirements of the Iron Works Combine at Stalinstadt.

9. Choosing a Suitable Site for Research

Even if the above-mentioned labor forces were available, the problems facing the institutes are still so great that in the future they must be at least partially solved by the trade itself. For this purpose, industrial research and development facilities are presently being constructed in the mills at Freital, Groeditz, and Riesa, as has already been done at Brandenburg. All research and developmental work of an industrial nature, such as improvement of techniques used in a particular mill, should be carried out at these sites.

Relieving the institutes gives them the possibility in the future of doing more basic research and pursuing new developmental ideas, as was formerly done. Thus this would also be a technical advance to accelerate ferrous metallurgy.

EAST GERMANY

Nonferrous Metals in the Chemical Industry Program

[This is a translation of an article by Georg Sille in Neue Huette, Vol IV, No 9, October 1959, Berlin, pages 584-592; CSO: 3222-N/b]

As a large consumer of soft coal and coke and as a shipper of raw materials for the construction of machines and small industries, the chemical industry plays the leading role economically. The projected doubling of the chemical industry program in 1965 as compared to 1958 must therefore have a variety of effects on our entire industry and on all facets of our lives.

The competition of the chemical industry program makes great demands on almost all the branches of our economy, particularly on metallurgy. The following should portray the part of nonferrous metallurgy in this enormous undertaking. This example is the gigantic chemical enterprise VEB "Walter Ulbricht" Leuna Plant. Essentially, the examples shown here are valid for all chemical plants in our republic.

The considerable increase in the production of the most important products of the chemical giant at Leuna necessitates an enlargement in the production of the entire plant, starting with the delivery of coal over the low-pressure gas generator, the gas compression, the manufacture of intermediate and market products for all subsidiary industries such as power generators, measuring and standardizing techniques, analytic laboratories, transportation industries, machines shops, and social industries.

The extent of the raw material used in all these industries must be grasped, since the transport industry--as, for example, in the construction of machines, apparatuses, and containers, as well as in the energy and eletrotechnical delivery industries--must convey its requirements in nonferrous metals itself. The quantities and prices of nonferrous metals consumed by these industries is thus non handled through the VEB Leuna Plant.

The basic numbers in the consumption diagrams are essentially in metallic raw, primary, and intermediate products which are important for factory remodelling in the industrial plants.

The numbers given are therefore considerably smaller than the effective consumption.

The utilization, need, and exchange of important nonferrous metals will be discussed in the following sections.

1. Zinc in the Chemical Industry Program

The world-wide consumption of zinc has moved about 2,750,000 tons since 1955. Zinc production has gradually grown from 2,800,000 tons (1955) to 3,100,000 tons (1958). The remainder of about 350,000 tons has of course had its influence on the price of zinc.

On a world-wide scale, galvanizing plants are the main consumers of zinc. Of these, plants for hot galvanization use about 30 percent of the total production (about 900,000 tons). In the electroplating industry, plants for galvanizing by the spraying method and sherardizing play a much smaller role than those for hot galvanizing.

Another 30 percent of the consumption goes to rolling mills and wore-drawing plants to be worked into zinc sheets, zinc strips, and wire.

Approsimately 40 percent of the total consumption is used for making alloys (for example, nonferrous metal), for preparation of ainc type and for raw material of paints having a linseed oil-alkydal basis.

In contrast to the world-wide ~~zinc~~ consumption, the yearly zinc consumption of the Leuna VEB is diminutive. This is partly due to the fact that this metal may be used only in specially prescribed cases as a solid metal and also as a surface protection. With the assumption of production in our first zinc smelting plant at Freiberg (Sa.), the consumption of the zinc will jump upward. Apart from this

measure, the chemical industry program may be counted upon to constantly increase the zinc consumption until 1964 (Figure 1).

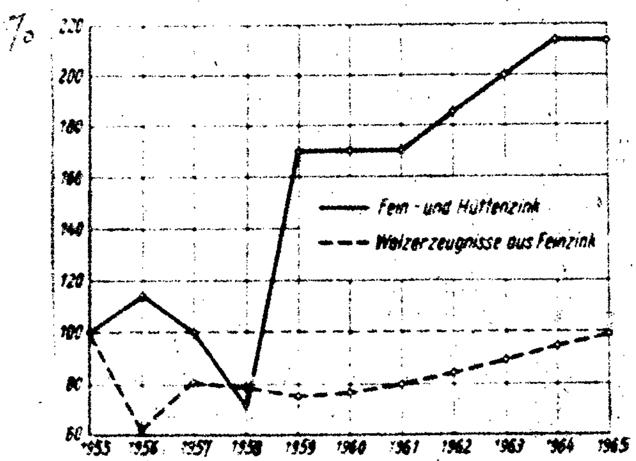


Figure 1

Percentual increase in zinc Consumption of the VEB "Walter Ulbricht" Leuna Plant, 1955-1965

——— fine and metallurgical zinc

----- rolled products from fine zinc

The essential part of the predicated zinc (about 70 percent) will serve for hot galvanization of packages and containers, sheets, strips, and pipes. In contrast to this, the consumption of zinc sheets, strips, and wire is insignificant.

A considerable percentage of the organic export production requires hot galvanized packaging before shipment. Only a small part of these containers are returned, so that the consumption of galvanized containers will always increase with rising organic production.

Zinc sheets and also hot galvanized sheets, pipes, and strips play an ever more important role in the realm of repair and investment, in spite of decreased state expenditures. Thus, for example, steam hoods and steam pipes of laboratories and factories are being made from zinc, or hot galvanized zinc sheets having a suitable temperature range. Similarly, pipes for hot water lines, and covers for insulation and disposal pipes, as well as gutters and spouts of buildings in a particularly harmful atmosphere are hot galvanized.

Worthy of mention is the consumption of zinc dust (blue powder) for diffusion galvanization. Diffusion galvanization has proven to be an excellent surface protection in hydrations against attack by sulfur in a reducing atmosphere under conditions of high pressure at temperatures of up to

500 degrees centigrade. The steam-galvanized parts as compared to the unprotected material have a four to five times longer life span. Attempts to replace steam galvanization as protection against sulfur by coating with aluminum have not been satisfactory in any case. Admittedly, however, coating with aluminum has limited justification as a special protective coat.

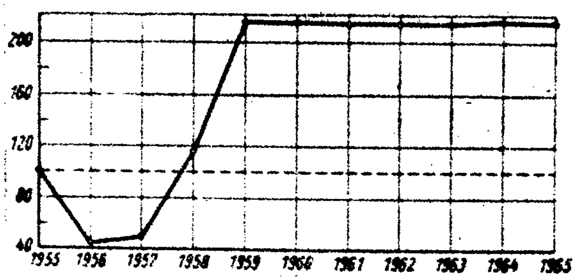


Figure 2

Percentual Increase in Consumption of Rolling Mill Products from Brass in the VEB "Walter Ulbricht" Leuna Plant

The part that zinc plays in nonferrous metal consumption is not reflected in the curves of Figure 1. It can be taken from Figure 2. It is approximately three times greater than the consumption of the previously mentioned cases. Brass and tombac are irreplaceable in many interchanges of heat, in the precision instruments industry, and in electrotechnolysis; in short, where their physical properties in conjunction with their chemical stability cannot be replaced.

In industry zinc plays no role in the casting of zinc type. After the bad experiences of the 40's, casting zinc type of a lesser purity under the conditions of harmful atmosphere in industry have yet to be reintroduced. Zinc alloys have also not worked out very well as antifriction metals, which would be desirable for a new introduction. However, a new region of utilization for zinc is opening in paints, where zinc dust and/or stamped zinc foil, as well as zinc chromite is gaining significance for basic as well as covering coats of paint.

Finally we come to the question of the replacement of zinc by synthetic materials. It must not be forgotten that with synthetic materials and rubberizing at temperatures up to 90 degrees centigrade (for fluorethylene up to 180 degrees centigrade) the hot-, electro-, and spray galvanizations are dispersed. This fact will soon have an effect on the packaging and plumbing industries. For approximately the same expenditure, synthetic materials hold up distinctly better and are more easily cleaned. The present degree of replacement of zinc by PVC [polyvinylchloride], or aluminum foil is, at least for gutters and spouts, far from satisfactory. This is because present day synthetic materials have cold-brittle-

ness and a tendency to age under the influence of light and heat, thus damaging the material and giving rise to extensive repairs. Modern plastics and plastic covers will replace hot galvanized materials more and more, even in kitchen and household appliances (for example, buckets). The same holds true for surface protected sheets for roofing purposes.

2. Lead in the Chemical Industry Program

The world consumption of lead in 1958 was about 2,500,000 tons. The significant consumers were:

The cable industry, about 40 percent
The battery industry, about 20 percent
For the lining of chemical apparatuses and containers, about 25 percent
For pipes, antifriction metals, lead alloys, paints, and chemicals, about 15 percent of the consumption

In the United States and several West European countries, the consumption of lead has been reduced considerably since 1956 (in 1956 by 60,000 tons, in 1957 by 40,000 tons). In the remaining countries the lead consumption has risen. The stagnation of the automobile industry is considered to cause a decrease in lead utilization by requiring less lead for batteries.

Modern hydration processes, which yield aromatic gasolines having a higher octane number, have strongly reduced the use of the health-damaging tetraethyl lead additives. It is also encouraging that the production of highly anti-knock propellants are given special consideration in the chemical industry program. Thereby the production and utilization of the lead containing anti-knock materials are being reduced.

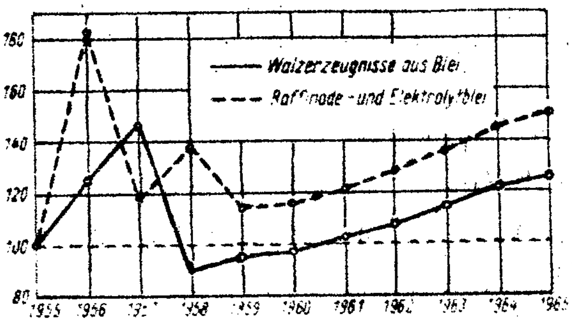


Figure 3

Increase in Lead Consumption of VEB "Walter Ulbricht" Leuna Plant, 1955 to 1965

——— rolled products from lead

------ refined and electrolytic lead

The lead consumption of the VEB Leuna Plant fluctuated greatly until 1958 but has since shown a tendency to increase (see Figure 3). The greatest part of the consumption lies in the region of the homogeneous coating with lead of large chemical apparatuses, evaporators, and autoclaves.

In spite of the very unfavorable durability of lead and its slight resistance to wear, as well as its poisonousness, lead corrosion products have proved themselves under industrial conditions in the homogeneous coating with lead as a surface protection against sulfuric and carbonic acid media. The curtailing suggests that coating with lead is not an ideal solution for the corrosion problem and that a high expenditure for repairs is required. The reason that lead could not be replaced by molybdenum-containing corrosion-resistant refined steels of the type X 10--Cr, NiMo, Ti, 18.10.2 was partly economic and partly that the technical procedure required special corrosion conditions. Besides its utilization in the production of ammonium sulfate, urea, and sulfuric acid, homogeneous leading generally also justifies its existence in its utilization in lining apparatuses for reduction, in the production of synthetic materials, and in the oil, fat, and soap industry.

Furthermore, lead plays a considerable role as material for pipelines, valves, and armatures as a main construction material as well as a lining material. It must be noted, however, that at up to 70 degrees centigrade the modern synthetic and rubberized materials slowly but surely are coming to the foreground because of the cost of lead.

In the field of cable encasing and the manufacture of batteries for electric freight trucks in industries where fire is a hazard, lead will not soon be replaced. The chemical industry, with its "aggressive floors" is not likely to

do without lead for encasing cables. (The parts of lead used for cables and batteries are not contained in the lead balance in Figure 3.)

Lead has greatly lost importance in pipes and sinks for houses and factories. It has been successfully replaced by ceramics and plastics. However, corrugated lead is industrially still important for the insulation of couplings. No satisfactory substitute has been found for this metal.

In the field of the use of isotopes, new prospects have opened the way for the replacement of lead as protection against radiation. At the very least, one can count on a diminished consumption of this material for sliding doors, windows, and the lining of air shafts. In these cases the heavy metal is being replaced by barium sulfate cement.

Also worthy of mention is the consumption of rolled lead for the protection of floor cements against the attack of chemicals. The synthetic oils occasionally utilized as a protective layer are not giving the desired results because of their insufficient mechanical properties.

The consumption of lead for antifriction metals at VEB Leuna Plant is still considerable. By the utilization of highly valuable lubricants, a considerably longer life span in the lining of bearings has been attained in 1950 as contrasted to 1945. The old unstandardized condensors, compressors, and steam engines, as well as the packing boxes, are, however, still driven by babbitted alloyed bearings. The exchange of babbit metal for lead bronzes and lead tim bronzes (with, indeed, considerably weaker pouring strengths) can be expected only upon changing over to modern machines.

Finally, lead must still be discussed as a raw material for paints. The typically good paint properties of red lead are the reason that lead compounds are still considered suitable raw material for basic coats of paint for construction in transport and pipelines. The future will show whether the modern zince chromate colors, zinc and aluminum as pulverized foil, are good and economical substitutes for the historically anciet lead colors. In accordance with importance, the preservation of facilities of large chemical factories and steel mills by purposeful painting techniques and by expenditures necessary for faultless paints must be given the required attention. The value of pure paints

plays a subordinate role in the systematic protective painting for scaffolding and rust protection, which cause high incidental expenses.

In summary, it should be noted that until 1965 lead metal is irreplaceable as a surface protector, as well as the main material for pipes and as spounts for armatures. There is, however, a justifiable desire to change over to the most valuable austenitic refined steels. On the one hand, however, this immediately assumes special economic measures and on the other necessitates analysis from case to case of localized corrosion and tendency to break under tension of the austenitic steel in order to determine if the steel offered is able to meet the industrial demands. Thus the utilization of austenites carries a considerable risk as compared to that of lead.

Hastelloy-alloys (nickel-molybdenum alloys) and titanium can be used in industry in the same way as lead. Their prices are so high, however, as to exclude their use except in special cases under conditions of particularly strong chemical attack and because of the basic knowledge of their corrosion-resistance their utilization would be worth the financial expenditure.

For cable encasements and for the battery industry, lead will continue in the future as heretofore. The same holds for minium or red lead oxide as raw materials for paints.

3 Aluminum and Its Alloys in the Chemical Industry Program

The world-wide consumption of aluminum rose from 1950, with about 1,500,000 tons to 1956 with about 3,300,000 tons. Thus within four years' time it has more than doubled. The main consumers throughout the world are:

1. Transportation: In the construction of vehicles (express train coaches, rapid train cars, passenger cars, trucks, airplanes, and ships), by appropriate construction methods, a saving of weight up to 60 percent in the construction of the chassis and up to 30 percent in that of the motor may be achieved.

2. Architecture: The lining of facade walls and roofs as well as the internal architectural form of large buildings and houses.

3. Electrical engineering: High-voltage lines, cable encasements, electromotive developments, high frequency coils, and screening foil for field strength.

4. The packaging and conserving industries: The part used purely in the construction of machines is only a small fraction of the light metal consumption.

With respect to the aluminum consumption of the VEB "Walter Ulbricht" Leuna Plant, there must be considered in the first place the utilization of apparatus and container material intended as materials for electrical engineering. (The consumption figures for the electrical section were not included in the graph values.) For the next five years an increase in consumption of almost 100 percent is expected (Figure 4). The main portion of the consumption is in sheets and pipes from aluminum 99.5 and aluminum 99.8 isotopes. Light metal alloys play a very subordinate role. In special cases they are utilized as hydronalium 3, as silumin cast metal, and, very rarely, as duralumin. The eutectic silumin has proved itself in the manufacture of cast metals for pumps.

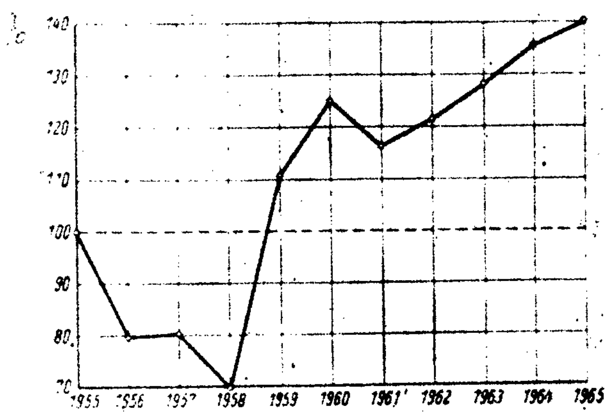


Figure 4

Increase in Consumption of Aluminum Rolling Mill Products in the "Walter Ulbricht" VEB Leuna Plant, 1955-1965

The good chemical stability of a boehmite protective layer--Al (OOH)--in known temperature ranges, in combination with the fact that dissolved aluminum salts and aluminum oxide neither discolor nor damage, make aluminum a material well suited for storage containers of organic products, as for example, pure formamide, pure formaldehyde, cyclohexanol, cyclohexanone, pure dimethyl amine, pure diethyl amine, pure diphenylamine and fatty acids (Figure 5).

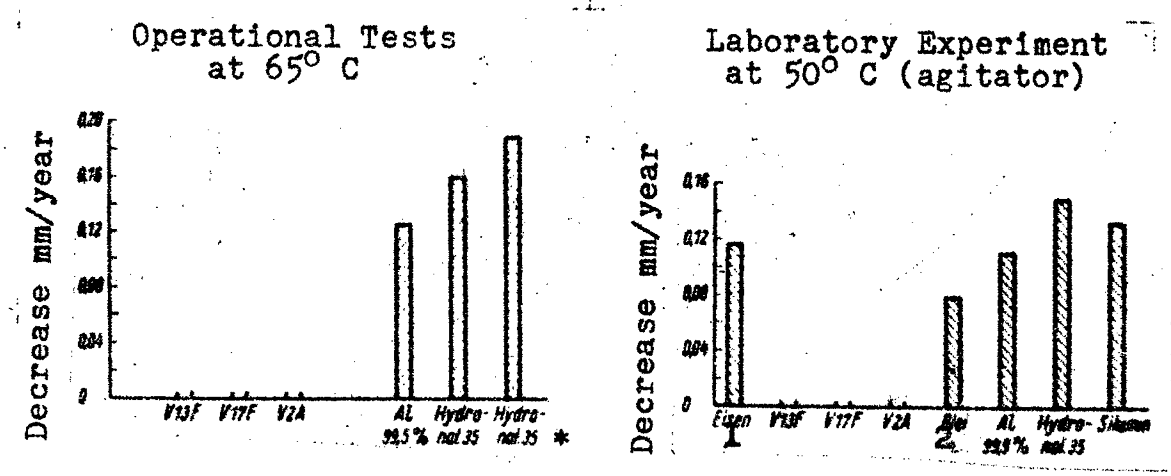


Figure 5

Corrosion Experiments Using the Formalin Technique

*with welding seams

1) iron; 2) lead

Since the production of high purity argon was started in Leuna in March 1959, the problem of faultless welding of aluminum compounds may be considered solved. However, the manufacturer still desires that the measurements of the rough and intermediate sheets be kept as large as possible in order to keep the welding operation to a minimum.

As a construction material for heat exchangers, aluminum is still hardly worthy of mention. From an industrial viewpoint, these apparatuses are difficult and not very reliable. This is because of their varied and, in chemical stability, strongly differentiated protective layer formation at critical temperatures, because of the tendency toward localized corrosion by the unpredictable penetration of chlorine ions in the cooling medium, and because of the softness and slight resistance to wear and the sensitivity to cavitation of aluminum metal. It is still used in this manner only in the refrigeration industry.

Important for industry is the fact that storage containers and heat exchangers made from light metals are very sensitive to hydrogen chloride. In the preparation and storage of chlorine-containing products it is absolutely necessary to take into account that secondarily, under the influence of

moisture, hydrogen chloride may not be formed and thus, as a consequent reaction, may result in a hydrogen explosion.

The refrigeration industry will always remain decisive for the consumption of aluminum. This industry, with its apparatus only slightly stressed mechanically, gladly utilizes the ductile aluminum for its excellent properties at low temperatures.

For somewhat greater demands on physical properties, apparatuses made from hydronalium 3 have held up well at -200 degrees centigrade and 5 atmospheres absolute pressure.

The importance of fine sheets of aluminum 99.8 in the gaseous phase for high pressure techniques must not be overlooked. It is usable for sulfur-fast sealing for apparatuses for hydrogenation and for petroleum chemistry in the permissible temperature range of about 400 degrees centigrade.

The portion of light metal castings used in large chemical industries is relatively small. The unsatisfactory properties of copper containing silicon 52 have done much to advance the discontinuation of silumin casting. In case eutectic silumin should again be deliverable, the consumption would probably increase again.

The light metal is irreplaceable as an alloy component of aluminum complex bronzes. These bronzes have proved to be conservable when faultlessly poured. The inadequate pouring techniques were, to be sure, often the reason for going over to the more sturdy and more wear-resistant chromium casts having 13 to 28 percent chromium.

Aluminum is hardly used any more for packaging purposes in Leuna as a large factory. Tubes for glues are being successfully produced from synthetic olein. These have replaced aluminum.

Worthy of mention is the use of aluminum in special cases as a material for shipping vats for organic export products. A better material for this use has not yet been found.

In the realm of architecture, aluminum does not yet have significance for us. Experiments carried out in Leuna have proved that within the industrial environment the corrosion by sulfur dioxide, sulfur trioxide, carbon dioxide, and other atmospheric impurities is so considerable that neither anodic

treatment nor protection by annealing lacquers or silicon compounds seem to permit recommendation of the utilization of light metals in the open (on facades).

The quantity of light metals used in the scope of electrical engineering is difficult to estimate. For us this material is unsuited for cable encasements laid in the open because of the contamination of the ground by harmful components.

Aluminum is utilized to a significant extent as an electrical conductor. Modern measuring and standardizing techniques will use aluminum in rapidly increasing amounts as a screening material.

As an ingredient for paints, heat-resistant colors, and wood lacquers, aluminum in an appropriate form is sure to take its place. As a diffused surface protection for increasing resistance to scaling, aluminum, and therefore aliting, is an emergency solution. In the long run, the brittle thin covers of aluminum-iron mixed crystals are unlikely to be a replacement for hot galvanization. Sprayed aluminum films have stood up well against atmospheric attack in industrial regions.

In closing, as concerns the question of replacement of aluminum by synthetic materials, the following position should be taken.

In the construction of apparatuses and containers, synthetic materials or synthetic protective films will not replace aluminum. On the contrary, the austenitic refined steels may make inroads into the aluminum domain. This assumes that our refined steel industry is in a position to deliver sheets and pipes of favorable dimensions in faultless quality.

For us aluminum is irreplaceable in architecture at the present time. In the packaging industry, synthetic oleins have replaced light metal in industrial importance.

In the field of transport the problem is not to be debated.

In the realm of electrical engineering the utilization of fine sheets and wires of purest aluminum can be counted upon to increase.

4. Copper and Its Alloys in the Chemical Industry Program

The annual world-wide consumption of copper is about 4,000,000 tons. Since 1955 it has remained at the same level, thus not showing any tendency to increase.

The utilization of copper at the Leuna Plant has increased steadily since 1955 (Figure 6). It is still increasing in the Seven-Year Plan. The decrease of the wire bars portion is explained in that the consumption of cast alloys (bronzes, brasses) is decreasing. Since the percentage of copper intended for cast alloys is only a small fraction of the total copper utilization, this amount plays a very subsidiary role in respect to the entire consumption.

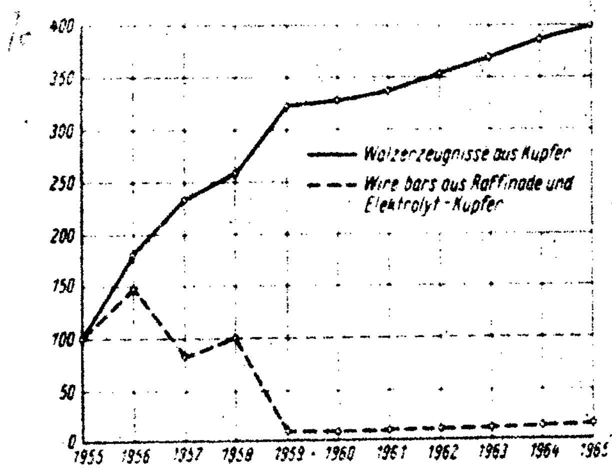


Figure 6

Increase in Copper Consumption at the VEB "Walter Ulbricht" Leuna Plant, 1955-1965.

——— rolled products from copper

----- wire bars and electrolytic and refined copper

Alcohol synthesis is the main copper consumer in Leuna. In the production of methanol and isobutylalcohol from carbon monoxide and hydrogen at approximately 350 to 450 degrees centigrade and 240 atmospheres absolute pressure, the industrial apparatuses should have the following properties:

1. They must be sealed to hydrogen in the quoted temperature and pressure range.

2. They must be sealed to carbon monoxide.

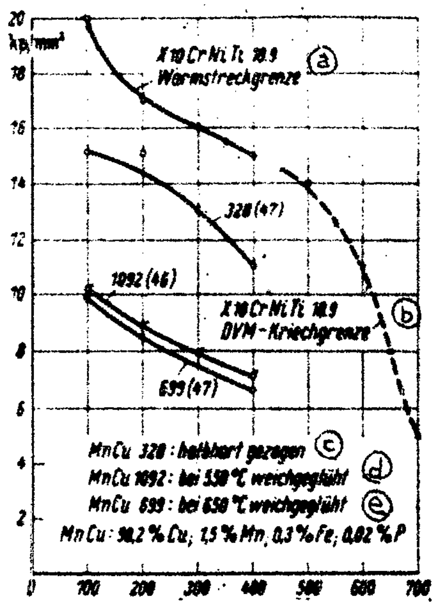
3. They must exhibit sufficient control over a period of time.

4. They must not influence the synthesis catalytically and must not form any compounds with the reaction productions (such as methylates).

These conditions are fulfilled by copper deoxidized with an excess of manganese. This is known as cupromanganese, or

manganese bronzes. As standard values it contains 98.6 percent copper to 1.4 percent manganese. If free from oxygen occlusions, this alloy is impermeable to hydrogen under industrial conditions. According to experience, a content of ferrous oxide has a damaging effect. The iron content of the alloy should therefore be less than 0.3 percent.

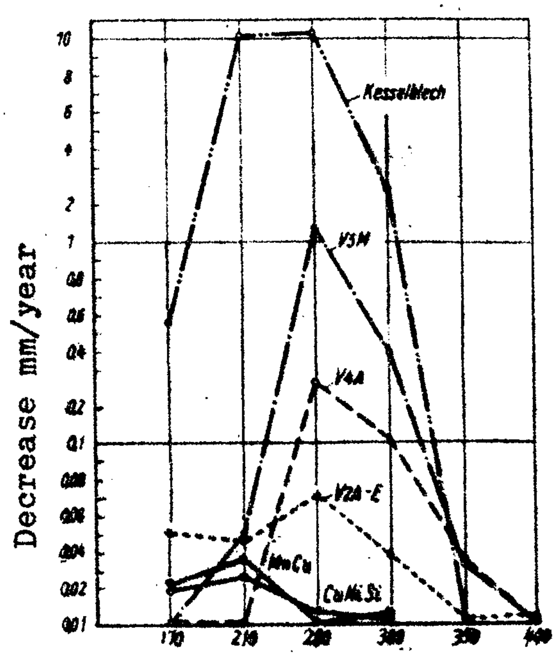
With respect to carbon monoxide stability, cupromanganese should be designated as quite usable in practical industrial fields. In this respect, it is considerably better than austenitic refined steels (Figure 7). However, the state of the manganese-copper alloy is unsatisfactory over a period of time (Figure 8). In the semisolid drawn out condition,



Running Temperature °C

Figure 7. Behavior Over Time of Cupromanganese and X 10 Cr Ni Ti 18.9

a) heat yield limit
b) creep limit
c) semi-hard drawn
d) soft-annealed at °C



Experimental Temperature °C

Figure 8

Experiments with Carbon Monoxide Effect on Various Steels at 250 atmospheres Absolute Pressure

the endurance strength suffices for its utilization. However, since synthetic reactions tend to thermic transmission, the first temperature excess over the annealing temperature of the cupromanganese (550 degrees centigrade) is coupled o the lowering of heat resistance.

Under the influence of the industrial pressures, the remaining reaction temperatures are then disturbed, thus leading to disuse of the apparatuses. The austenitic refined steels have a considerably better behavior over a period of time.

Laboratory experiments to obtain a more heat and disturbance-resistant nonferrous metal alloy than the cupromanganese resulted in copper-nickel-silicon-bronzes which may be aged and which have approximately 97 percent copper, 2 percent nickel and 1.0 percent silicon. With the same hydrogen- and carbon monoxide impermeability, these have noticeably more heat resistance than does cupromanganese (Figures 9 and 10). Vaious set-backs in most recent times with cupro-

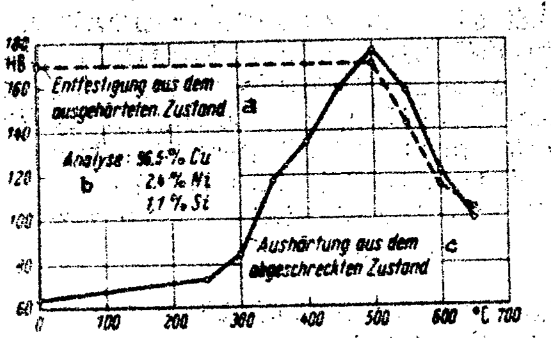
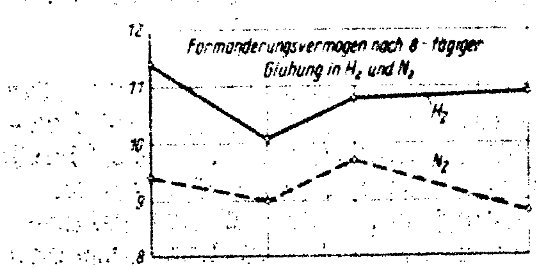


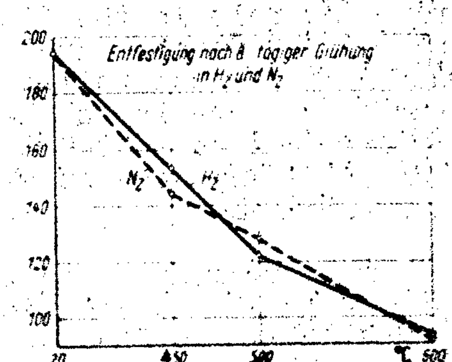
Figure 9. Influence of Heat Treatments on the Hardness of a Copper-Nickel-Silicon-Bronze

a) dehardening from the age-hardened state
b) analysis
c) age-hardening from the quenched state

Figure 10. Influence of Annealing Treatment in Hydrogen and Nitrogen Atmospheres on the Properties of Age-Hardened Copper-Nickel-Silicon Bronz.



a) form alteration capacity after an eight-day annealing period in H_2 and N_2



b) dehardening after an eight-day annealing period in H_2 and N_2

manganese, as well as difficulties in obtaining the copper-nickel-silicon bronzes, resulted first in the manufacture of larger forgings from the refined steel X 10-Cr, Ni, Ti 18.9 in place of the cupromanganese, and then in their industrial testing. If these experiments yield positive results, the changeover from cupromanganese to austenitic refined metal can be awaited with certainty. Furthermore, the greater solidity of the V2AE permits the construction to be lighter in weight.

A number of organic chemical high- and intermediate-pressure catalyzers require construction materials which do not disturb the course of the reaction and/or do not lead to any cracking of hydrocarbons on the pipe walls. Copper and its alloys (rolled bronzes) have proved their competence as such construction materials. However, even here the slight heat resistance of nonferrous metal is disturbing. As a remedial measure for this disadvantage, copper plating on heat-resistant tempered steels and fireproof steels has been successfully introduced. Since the acquisition of plated construction materials was too cumbersome, besides high percentage ferritic chromium steels, electro-chromium plating and the fastening of armored plates containing a high chromium percentage were trid on steel surfaces with varying degrees of success. Difficulties in welding compounds having a tendency to be brittle when hot, such as high-percentage chromium steels, as well as the natural and unavoidable porosity and fissures in electroplated chromium coats are reasons still delaying their development.

Copper and its homogeneous alloys--in particular the aluminum-free special bronzes and brasses--play a quite significant role in the field of air-liquifaction as a result of their favorable ductile behavior at low temperature and their easily controlled behavior on annealing. In this field, however, there is in the foreground the question of the utilization of austenitic chromium-nickel steels or of chromium-manganese steels in the place of nonferrous metals and aluminum.

It is noteworthy that the refined steel industries of the entire world are considering the further development of low-temperature ductile chromium-manganese austenites. Difficulty in manufacturing them into sheets and pipes, as well as in welding, are the only things hindering the use of chromium-manganese austenites in place of copper. In the investments up to 1963 we still considered copper as the construction material for facilities for the liquifaction and separation of gases.

Primarily for casting, a notable consumer of nonferrous metals is indeed--or, more correctly, was--the construction of apparatuses for ventilators, washers, rotary pumps, rackers, propellers, stirrers, and valves. However, even here there is a tendency to change over to light metals, ferric casts having a high percentage of chromium, or austenitic cast chromium-nickel. This development will be strengthened when it is possible to deliver better, denser, and more finely granulated castings.

Without question, the production of high-percentage chromium and chromium-molybdenum castings as well as austenitive chromium-nickel-molybdenum castings have, under a good founding procedure, higher resistance to corrosion, wear, and cavitation.

Nonferrous metals still take a leading position in the construction of absorbers, heat exchangers, preheaters, and condensers in industry in the realms of chemistry and power. Plated construction materials have given satisfactory results when used for the encasements and bottoms of these apparatuses. Muntz metal bottoms are scarcely in existence any longer. Brass is the most favorable construction material for baffle plate sheets. Hot galvanized steel is to be considered as an emergency solution. The utilization of igelite (PVC) as a construction material for baffle plates is to cautioned against, since under industrial conditions the polyvinylchloride can give rise to chlorine which quickly destroys nonferrous metals in the bores by hydrogen chloride attack.

Besides copper, the marine alloys having 70 percent copper, 29 percent zinc, and one percent tim and Ms 72 F35 have proved useful as raw construction materials. Recently a Ms 72 F34 was built from CSR imports which had 72 percent copper, 0.9 percent time, one percent aluminum, and residual zinc. This will prove whether, under relatively mild thermic stress, it is sufficiently resistant to the very strongly saline waters of the Saale, which are polluted by the wastes of the refrigeration industry.

In the realm of the food industry, copper has lost greatly in significance. It is being replaced extensively by aluminum, rust-free and corrosion-resistant steels, enamel, glass, porcelain, and--at temperatures up to 80 degrees centigrade--plastics.

Copper is hardly being used any more in the construction inudstry for roofs or outdoor encasements.

As before, nonferrous metals are irreplaceable as stock construction materials because of their good properties in functioning. Since the production of ball bearings and rollers bearings is being energetically pushed, large bearings and babbitt bearings will claim the highest quality of ternary lead-tim-bronzes and secondary lead-bronzes for high-speed machines having constant rates of revolution, as , for example, internal-combustion engines, Diesel motors, compressors, crank shafts, and connecting-rod bearings. The insensitiveness of nonferrous metals to dust and dirt is remarkable.

For high-speed friction bearings with v > 45 m/s the WM 80 compound system (lead bronze) steel is still the best solution for construction materials because of its good oil resonance, and heat transmission.

Babbitt bearings or large bearings of the ternary lead-tin-bronzes remain recommendable for grinding machines and precision bearings with noiseless motion. For wheel bearings, link brackets, landing gear bearings, press and bell crank with low speeds, cast aluminum and special bronze compound castings remain useful as heretofore for measurements up to one hundred millimeters diameter. For larger measurements G Al MBz large castings are used.

Large bearings of ternary lead-tin-bronzes for large bores (up to 700 millimeters in diameter) for heavy machinery with small peripheral speeds and high abrasion may not be replaced. This is due to good oil adherence to lead when the lead content is over 18 percent. Thus an effective and indestructible oil film is formed. It is necessary to have a good lead distribution and a high quality structure for the bearing material. This holds for rotary tube bearings, crusher bearings, roller-frame bearings, glazing, roller bearings, cold-running (kaltgehender) bearings, and mixing machine bearings.

Copper still has undiminished importance as an electric conductor. Penetration by aluminum into this area, which formerly was reserved exclusively for copper, has hardly yet succeeded in most recent times.

Electrical analytical and standardization techniques are causing an increased consumption of nonferrous metals. Even though an individual instance may not require a large amount, the diversity of utilization of these techniques and their advantages (saveing work and improving management) will disclose a valuable market for purest copper.

In summary, it may be established that a lessening in copper consumption for the construction of apparatuses for large chemical industries is to expected. Copper has also lost its pre-eminence for the manufacture of combustion chambers, apparatuses for the food industry, and the construction of founding apparatuses.

On the other hand, copper alloys are still the most favorable construction material for heat exchangers. Even here, there is nevertheless a growing tendency against the use of nonferrous metals with their polyamide-, polyethylene-, or fluorchloroethylene encasements which specify the usable temperatures. The dissipation of heat by the synthetic materials is compensated for by the glass-like surface, the possibility of its being easily cleaned, and the good chemical resistance to industrial conditions (no dezincking and voltage breaks, no localized corrosions).

Bronzes are hardly to be replaced as construction material for friction bearings.

Copper will successfully defend its leading position as a construction material for electrical conductors. Control techniques will discover new and diverse possibilities for utilizing this metal.

5. Rare Metals and Metal Alloys in the Chemical Industry Program

For the sake of the completeness of this report, the importance of nickel, cobalt, titanium, tantalum, and semiconductor materials will be considered. Large chemical industries are hopeful of increasing considerably the variety of raw materials available by the use of these elements.

According to significance, nickel would be the first to be mentioned. Whether or not the quantitative production of sheets, pipes, and wires of purest nickel, monel, nimonil, Inconel and the Hastelloy alloys would be worthwhile within

the scope of the GDR shall be left undecided. With extensive demands for austenitic chromium nickel steels with 18.9 Cr Ni, 19.12 Cr Ni, 16.16 Cr Ni, 18.18 Cr Ni, 18.22 Cr Ni, 20.25 Cr Ni, and 16.60 Cr Ni (with or without additional alloyed components), the production of purest nickel and its subsequent processing into the above alloys in the form of sheets, strips, pipes, and wires must be given special attention. Besides these alloys, which are eagerly sought because of their resistance to corrosion, alloys based upon nickel and/or chromium-nickel that were smelted under vacuum and in the subsequent handling were annealed under a protective gas play an important role in analytic and controlling technology. They are used for heat conduction and temperature measurements. Also important are invar and permalloy, which have good applicabilities because of their good thermic ratio of expansion and their high magnetic permeability.

Furthermore, cobalt is to be considered within practical limits. Efforts to let chemical reactions run their course under high pressure at temperatures greater than 650 degrees centigrade have failed up to now because appropriate construction materials were not available. Their development must not be delayed. In the future, the most heat-resistant austenites having the approximate alloy composition indicated (in percent) will be needed.

Chromium	Nickel	Molybdenum	Cobalt	Other Alloy Components
16	13	2	10	+ Nubidium + Tungsten
16	20	3	20	+ Nubidium + Tungsten
20	20	4	45	+ Nubidium + Tungsten

Stellites with a high cobalt content, or any hard alloy, will be unlikely to be dispensable.

Because of its resistance to chlorine solutions, acetic acid, chloroacetic acid, chromic acid, hypochloride solutions, nitric acid, hydrochloric acid, as well as dulfuric acid in certain temeerature and concentration ranges, titanium in the form of sheets, strips, pipes, or forgings has become a hardly dispensable construction material for the chemical industry. Of course its high price opposes its extensive utilization. Whether it would be worthwhile to erect some manufacturing and subsequent processing plants within our republic must be cautiously investigated.

Tantalum has proven to be a suitable construction material for absorption facilities which are charged with hot hydrochloric acid. Since large amounts of tantalum are not required for this rare application, the conclusion drawn for titanium is also valid here.

In closing, several other elements bear mentioning. They cannot be manufactured in highest purity without a modern analytical and standardization technology. The following are concerned: selenium for rectifiers, photo-elements, and apparatuses for infrared techniques, and the elements silicon, antimony, and germanium which have been utilized in 5-Neuner [not identified] purity as semiconductors, which are required for diodes and transistors as luminescent materials (manganese germenate), as a raw material for wode-angle objects, and as a noble metal plummet (Edelmetallot) containing 12 percent germanium.

Gratifying and considerable successes in the manufacture of these highly purified elements have been obtained in laboratories in Eisleben. Therefore, our industry is no longer dependent upon imports. It is to be hoped that these favorable developments in metallurgical engineering and chemical transitional areas will continually advance and that analytical and standardization technology will keep in step with the production of highly purified semiconductors. Thus the enormous achievements of modern science and technology would become useful in their fullest extent to all factories, thereby satisfying in all respects the necessities of life.

1781

EAST GERMANY

Finished Refractory Concrete Parts--A New Branch of The East German Refractories Industry

[This is a translation of an article by E. Kuntzsch and G. Rave in Neue Huette, Vol IV, No 9, October 1959, Berlin, pages 623-625; CSO:3222-N/c]

In support of the chemical industry program, the engineers and technologists of the VEB Silicate and Fireclay Factories in Rietschen agreed to be responsible for producing finished refractory concrete parts and for introducing the finished units to the consumer industries. This innovation is significant, especially now since it helps to overcome the current bottleneck in refractory products. Furthermore, in using these finished units, new ways will be tried even in the construction of industrial furnaces. Thus the goal of developing large zie prefabricated units which can be produced, transported, and finally installed entirely mechanically is being pursued. The conventional methods--in particular the preparation of quickly opening furnace parts with considerable waste of labor--shall herewith be replaced by better ones.

Refractory concrete is understood to be a fire-resistant concrete which is produced by utilizing pure clay cement.

The composition of pure clay cement, which is also known as pure clay aluminous cement, generally varies, according to H. Kuehl, within the following limits: 5 to 15 percent SiO_2, 30 to 50 percent Al_2O_3, 5 to 15 percent Fe_2O_3, 1.5 to 2.5 percent TiO_2, 35 to 45 percent CaO, and 0.5 to 1.5 percent MgO.

The pure clay cement delivered from the VEB Electric Smelting (Elektroschmelze) in Zschornewitz has the following composition, in percent:

	Percent
Loss on ignition	0.27
SiO_2	3.65
Al_2O_3	48.72
Fe_2O_3	4.88
CaO	36.95
MgO	0.09
SO_3	0.07
Indissoluble materials	4.80

According to the utilization intended, crude fireproof clay, sillimanite (Sillimanite), chrome ore, and chrommagnesite may be considered as aggregates for the production of finished refractory concrete units. Cantilever construction units, such as arch components, covering panels, and exhaust gas slides are protected by rounded steel (Figure 1).

The production of these finished construction units in the VEB Silicate and Fireclay Factories in Rietschin takes place in a manner unusual for the refractory industry. The jar-ramming process as well as the vibration method are utilized for internal compression. Thus the mixing ratio of cement to crude fireproof clay is held at 1:4 or 1:5. Crude fireproof clay, usable as an aggregate up to 1,350 degrees centigrade, is utilized in granules up to 15 millimeters in size. Although thermic stress is the determining factor for the mixing ratio, the grain size of the aggregates varies according to the size of the construction unit. Thus, for example, for a briquette weighing 100 kilograms, a grain size up to 8 millimeters would be used. The granular increase of a batch follows the Litzow curve. The aggregate is ground in a ball mill and mixed with the fireclay cement in a portable 250-liter free-falling cement mixer. The water added varies according to the manufacturing process. The weight of the finished construction unit depends on the transportation possibilities and the specific requirements of the furnace installation intended for its preparation. Up to the present time the largest prefabricated construction unit of refractory cement had a weight of 1.3 tons, including the steel protection. It was an arched part of a vertical ingot-heating furnace (Figures 2 and 3).

The prefabricated manner of construction would derive particular significance if it succeeded in combining the previously small and complicated brick arches into larger simple construction units. For economic reasons, the minimum weight of such finished units must be around 50 kilograms. Most of the sizes prepared up to now had weights between 300 and 600 kilograms.

Chipping the refractory units after they have set is possible only with the greatest difficulty because of their high initial solidity of over 350 kp per square centimeter. Therefore, the greatest attention must be given to technical format questions. Grooved and ribbed shapes are basically also producible; however, the thickness of grooved and ribbed surfaces must be in accord with the unit weight. This is to keep the production and transportation difficulties as small as possible

Refractory concrete units, according to the mixing ratio and the type of aggregate materials, have, at room temperature, the properties given in Table 1.

Table 1

Quality Factors of Two Different Pure Clay Cement Batches

	Batch Number I	Batch Number II
Approximate density, in grams per cubic centimeter	2.11	2.80
Absorption of water, percent	6.05	1.85
Total porosity, in percent	19.7	12.3
Apparent porosity, in percent	12.7	5.16
Resistance to cold compression, in kp per cubic centimeter	340	400
Resistance to heating under pressure (Druckfeuer) ta/te° C	1,310/1,420	1,420/1,460

Diverging from the behavior of known fireproof materials, refractory concrete shows an increase in porosity of about 150 percent during annealing. The compression passes through a minimum as shown in Figure 4. [following page]. This is dependent upon the alumina fusion properties, upon the chosen mixing, and upon the type of heat treatment. The subsequent increase in solidity every time indicates the inception of vitrified bonding, which occurs in the higher temperature regions in place of hydraulic bonding. The behavior of the

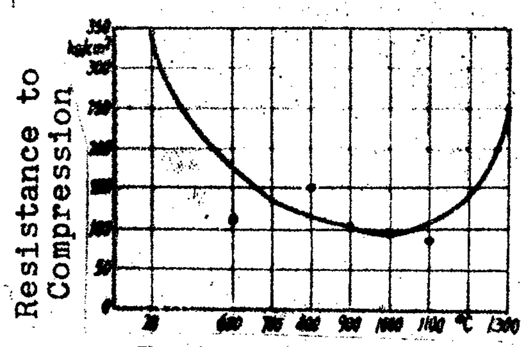


Figure 4

Course of Resistance to Compression of Refractory Finished Concrete Construction Elements during the First Heating

refractory concrete elements under changing temperatures and the influence of slags have been investigated only to a small extent so far. After suitable preparation of these construction elements and their eventual protection, their stability to temperature changes is at least equal to that of fireproof clay construction elements of the same size. The thermic limits for the utilization of refractory concrete elements on one-sided heating are 1,350 degrees centigrade for FB [refractory concrete] fireproof clay; 1,450 degrees centigrade for Sillimanite FB; and 1,600 degrees centigrade for chrommagnesite FB. At these temperatures the post-contraction of the construction elements was within the limits which the TGL [not identified] prescribes for firebricks.

Utilization

Refractory concrete will be used primarily in place of firebricks in the temperature range of 300 to 1,200 degrees centigrade and in such places where the constructional advantages of prefabricated partially and completely finished units can be exploited. A new type of preparation using refractory finished concrete construction elements has been employed to datefor chemical reaction furnaces, for annealing furnaces in the treatment of metals, for baking ovens in foundries, for calcining kilns for ceramics, for preparing and covering waste-gas flues, for smoke slide-valves of all types, for finished construction unit doors for furnaces, for constructing industrial furnaces, and for preparing steam boilers.

While fireclay materials require a delivery time of eight weeks, the delivery time for refractory concrete construction elements is from four to fourteen days. This is particularly important for quick repairs in cases of breakdown.

Prefabricated refractory concrete elements can be shipped by all the usual means of transportation. Aids in transporting and assembling these units, such as supports, suspended or anchored rods are, according to requirements, embedded in the concrete so that the most modern transportation and quick assembly are possible. With dry storage the units are ready to be assembled immediately. Preheating (tempering) of the installed units can be undertaken according to the previous standard specifications of the consumer industries. The temperature increase may be from 30 to 50 degrees centigrade per hour.

Photo Captions

Figure 1. Exhaust gas vent as a finished refractory concrete construction unit with a round steel reinforcement for hanging. Weight: 458.4 kilograms.

Figure 2. Reinforced formed element to be used as a refractory concrete vertical ingot heating furnace finished construction unit.

Figure 3. Refractory concrete vertical ingot heating furnace finished construction unit with tie rods for transporting it five hours after finishing. Weight: 1,300 kilograms.

1781

Long-Term Planning for Electric Power in East Germany

/This is a translation of an article by E.Markus in Energietechnik (Power Technology), Vol.IX, No.11, Berlin, November 1959, pages 481-486, C.S.O.3406/N /

On October 1,1959 the People's Chamber adopted the Law on the Seven-Year Plan Concerning the Development of the National Economy of the GDR from 1959 to 1965. It includes great responsibilities for the power economy such as a great increase of electric power production up to 63 billion kilowatt-hours in 1965 which is 3,590 kilowatt-hours per head of the population.

In this period new power capacities of 6,500 million watt must be installed; among these are the big power stations of Luebbenau with 1,300 million watt and Vetschau with 1,000 million watt (1,200 million watt by 1966). Special peak load power stations with a total performance of approximately 900 million watt must be put into service to improve supply during peak requirement periods. The compound and distribution system must be greatly expanded for all voltages; 380 kilovolt surface ducts will be laid for the first time in the GDR.

These responsibilities formulated on the basis of socialist planning, are not at all arbitrary; they are based on research conducted on objective requirements. Needs and production are combined in a national economy balance which is similar to an equation system with numerous terms. The following analysis is concerned with the laws of one of these terms, namely the load conditions of electric power producers and transformers.

In the period under study electric power requirements are constantly on the increase. The always limited production volume of the national economy is increasingly used by investments and operational materials required for meeting these needs.

Higher requirements can be met only by favorable national investments if load conditions have been studied in regard to their structure and development and the observed laws are taken into account in long-term planning. The structure of the load conditions includes quantity, time and local requirements.

This time the study of the load structure does not start from an integration of the various consumers but considers the observed curve of the annual load in a certain geographic district a marginal requirement curve. The analysis is concentrated on the laws governing the type and development of the curve accurately reflecting the load structure. The basis of the analysis is formed by the statistical curves of the GDR for 1956,1957 and 1958.

The load curve or line of 1956 is the first which was established for the total load of the GDR. (Figure 1). It was made possible only by a socialist organization of the previously divided power economy. The curve gives an important insight into the load structure. However, still more important are the changes observed on the basis of a comparison of the annual lines of 1956, 1957 and 1958 (Figure 2).

The fluctuations of the annual curves permit conclusions in regard to their tendency of development. This makes it possible for us to check future annual curves resulting from the integration of planned requirements, in regard to their realism.

In particular, it will be possible to find future marginal curves of requirements without knowing the details of the various consumers; we assume only a steady and proportional development of the annual curves. Then there is the possibility of finding the annual curve of a certain region for which no statistical curve is available, on the basis of analogies with adequate accuracy.

On the basis of future marginal curves obtained in this manner, conclusions can be drawn for a kind of expansion of available power stations which is the most favorable one for the national economy.

This requires an analysis of the annual curves and the replacement of their irregular statistical shape by a mathematical curve with adequate accuracy. The average annual load is taken as a mean ordinate for this curve; in Table 1 it is computed for the years covered by the statistics; it is

confronted with the mean ordinate of the curves in Figure 2. The average value of the three deviations is 2.1 percent and can be considered negligible in this analysis.

Table 1

Year		1956	1957	1958
Annual Production A (Mill.MWh)[†]		31.2	32.7	34.6
Hours per Year T=a	(h)	8,784	8,760	8,760
Average Load $P_{average} = \frac{A}{Ta}$	(MW)	3,560	3,730	3,950
With $T = \frac{a}{2}$ the mean ordinate of the statistical curve is $\frac{Pa}{2}$	(MW)	3,650	3,800	4,030
Deviation $1 - \frac{P_{average}}{\frac{Pa}{2}}$	(%)	2.5	1.8	2.0

[†]) According to "Statistisches Jahrbuch der DDR" (Statistical Year Book of the GDR)

An example for the load construction is given in Figure 3 with the curve for 1958 for the same area. It is a trapeze whose surface is increased or reduced to the extent of the same value by a quadratic parabola. The corresponding statistical curve was entered in the figure for reasons of comparison; for our analysis the small deviations are neglibible.

The mathematical formula of the annual curve can be established on the basis of two data, i.e. the annual maximum load P_{max} and the mean load $P_{average}$, in such a manner that the structure of the load can be recognized. Figure 4 shows the mathematical form of the statistical curves of Figure 2.

On the planned or probable development of the annual maximum load and the average load, it is now possible to establish future shapes of annual curves and to read from these the structure of the loads to be expected. For certain regions such as bezirks, kreises or cities, for which no statistical curve is available but for which we have the annual maximum load and the average load, the approximate annual curve can be entered to replace the statistical curve.

An example is given by the annual curve of the GDR for 1965. The statistical values of Table 2 are taken as a basis. We recognize that the annual maximum load rises faster than the average load. The average annual growth rate is

Table 2

Year		1956	1957	1958
Annual Maximum Load P_{max}	(MW)')	4,650	4,935	5,420
Growth over 1956		100	106.1	116.6
Average Load $P_{average}$ from Table 1	(MW)	3,560	3,730	3,950
Growth over 1956		100	104.8	110.0
Load Factor $m = \frac{P_{average}}{P_{max}}$	(%)	76.3	75.6	72.9

') According to "Statistisches Jahrbuch der DDR" (Statistical Year Book of the GDR).

computed according to the equation

$$p = \sqrt[n]{\frac{P_n}{P_o}} - 1$$

p - Annual Growth Rate
n - Number of Years
P_n - Load in Year n
P_o - Load in first Year

With the values of Table 2 for the increase in maximum load p is $\sqrt[2]{1,166} - 1 = 8.0$ % compared to the average load with $\sqrt[2]{1,100} - 1 = 4.9$%. The ratio is 1.63.

As they are, these values cannot be taken as a basis for future developments because the period which was evaluated, is too short. For the seven years up to 1965 the annual growth rate of the average load can be assumed with 9.0 percent, for example, and the ratio, on the basis of the annual maximum, with 1.20, as a result of other factors depending on each other in the planning of the national economy, which will not be analized here. The above permits us to compute the annual

growth rate of the maximum load at 1.20 x 9.0 = 10.8 percent.

This is an increase of the average load to $(1 + p)^n = 1.09^7 = 183$ percent and of the annual maximum load at $1{,}108^7 = 205$ percent, over 1958. For 1965 we compute

$$P_{average} = 1.83 \times 3{,}950 = 7{,}220 \text{ (MW)}$$
$$(\text{or } A_a = 1.83 \times 34.6 = 63.3 \text{ (Mill.MWh) and}$$
$$P_{max} = 2.05 \times 5{,}420 = 11{,}100 \text{ (MW)}.$$

The corresponding annual curve can now be entered.(Figure 5).

In planning projects it is frequently more advantageous to compute with relative figure and not with absolute values. On the abscissa time refers to the possible number of hours during the year and on the ordinate the load refers to the annual maximum load. The scales are $\frac{T}{Ta}$ and $\frac{P}{Pmax}$, both in percent. For the analysis of the annual curves this value is particularly useful as it serves as an important basis for further conclusions. It must be pointed out that the given formation of the annual curve of approximately m = 45 up to 100 percent, can be applied.

Figure 6 shows the annual curves 1956, 1957 and 1958 in their mathematical form referred to the relative values. We start the computation with the load factors found from the statistical values. See Table 2. The planned annual curve for 1965 is also entered. Its load factor can be directly computed from the corresponding value of 1958 at $m = \frac{183}{205} 72.9 = 65.1$ percent.

In exactly the same manner the approximate mathematical annual curves can be obtained from the known load factors to be entered for districts for which no statistic curves are available such as Halle and Neubrandenburg (Figure 7). In 1958 these two districts showed the highest and lowest load factor respectively: Halle 83.5 percent and Neubrandenburg 48.2 percent. The GDR curve for 1958 is given as a comparison. The high load factor of the Halle district is explained by the chemical industry, the low factor in Neubrandenburg by the preponderantly agricultural structure of this district.

The load factor is a reflection of the origin of the requirements. If the changes in the load factor can be seen we can also establish the future form of the annual curve.

The type of annual curve gives us an insight into the structure of load conditions of a geographical region and

into the type of need of electric power; moreover, it gives us the possibility to draw conclusions for the required policies in connection with the power stations to be made available. This requires an analysis of the annual curve or the load factor.

The load factor corresponds to the mean load of power capacities and provides us with data on the duration of consumption in terms of time. A high load factor is desirable because it means a high degree of utilization of the stations. However, its value depends on the origin of the planned needs and can be changed by further planning and controlling measures within certain ranges only.

Unlike initial assumptions, a load factor of 100 percent is not possible in a planned economy because part of the requirements depend upon natural conditions such as daylight, temperature and ways of life. The requirements of electric power could not be met by arbitrarily increasing the value of the load factor for the available power stations to find a balance between requirements and production.

If the annual maximum load which can be computed from the maximum value of the load factor, which cannot be exceeded, is paralleled only by 90 percent of power capacity, we have no choice other than reducing requirements in the peak or basic ranges artificially by ten percent. Figure 8. In the former case it will have a direct impact on the population; in the latter case the effect will be indirect, i.e. industrial production will be curtailed. The objective must be to meet the overall need for electric power with efforts which are the most favorable ones for the national economy.

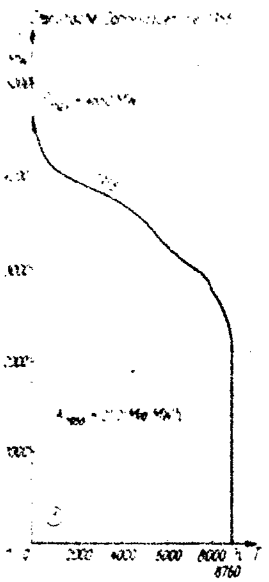
For the greater part, presently available capacities originate from the period when the power economy was divided up. If we divide the operational surface of the annual curve of 1958 into differential surface strips with a width of

$$\frac{\Delta P}{P_{max}} = \frac{\Delta f(T)}{f(T=0)}$$

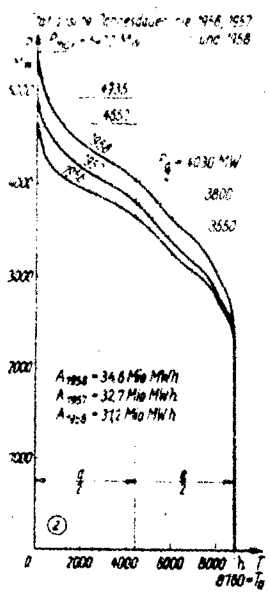
(Figure 9), the marginal value of ΔP does not tend toward 0 but corresponds to the load of one turboset unit.

The width ordinates of the surface strips are proportional to the ordinates of the summation curve. This means that with established power capacities not belonging to the planned economy, the fluctuations in the total load must , in general,

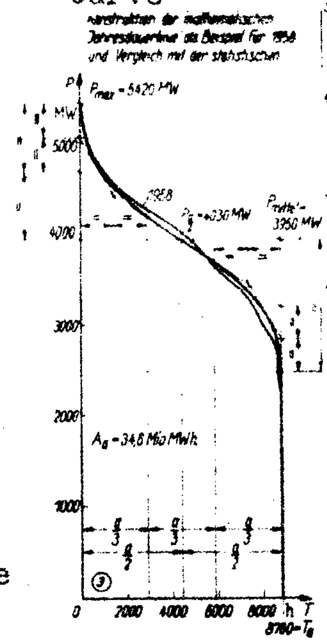
Statistical Annual Curve 1956



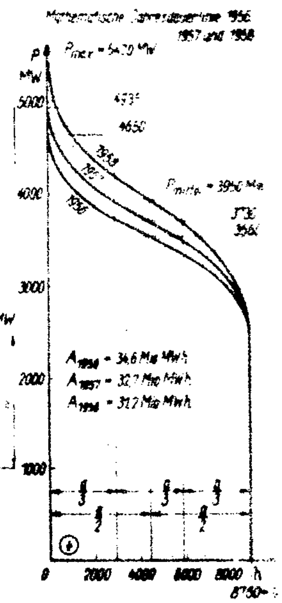
Statistical Annual Curves 1956-8



Structure of Mathematical Annual Curve as Example for 1958; comparison with Statistical Curve



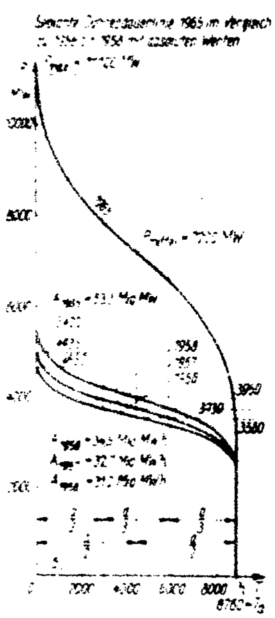
Mathematical Annual Curves 1956-8



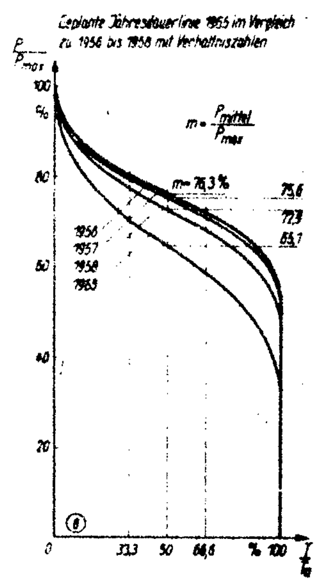
Mio - Billion

mittel - Average

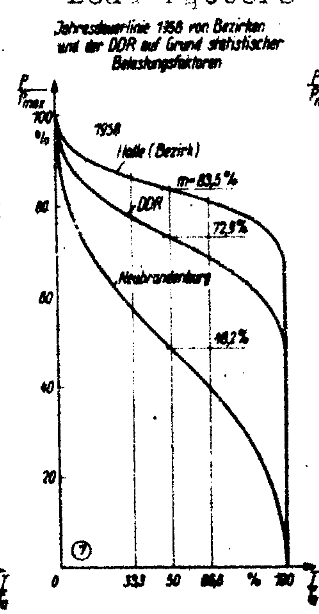
Planned Annual Curve 1965 compared to 1956-8 (absolute values)



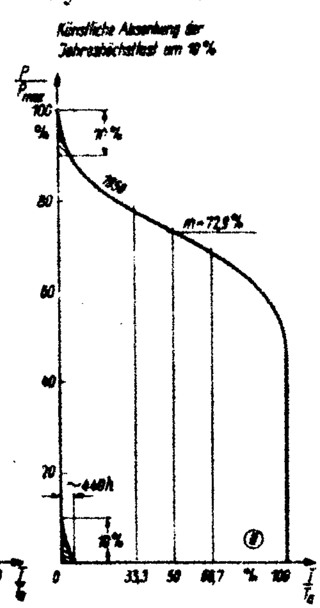
Planned Annual Curve 1965 Compared to 1956-8 (Relative Figures)



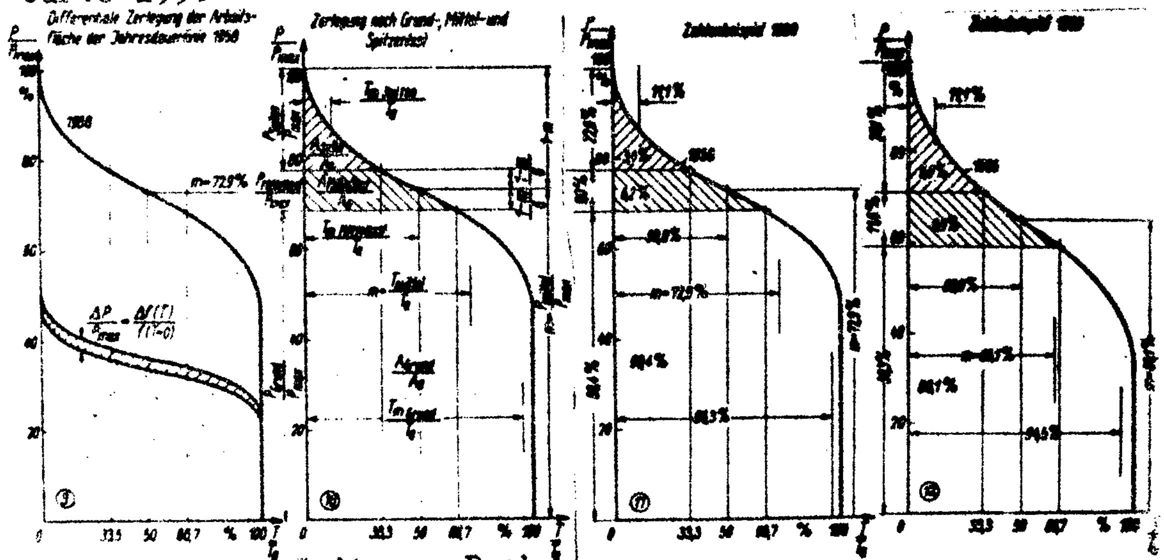
Annual Curve of Districts and GDR Based on Statistical Load Factors



Artificial Curtailment of Annual Maximum Load by 10 Percent



Differential Division of Operational Surface of Annual Curve 1958 | Division into Basic, Average and Peak Loads | Figure Example 1958 | Figure Example 1965



Spitze - Peak

be absorbed by each turooset.

This factor determined the technical design of the turbosets. In most cases the best efficiency degree of the turbine was planned for the total load factor of the combined system, for example for m = 70 percent and the more complicated charging organization was preferred.

If the power capacities are to be developed in a planned manner, it would not be appropriate to continue with these principles because they do not lead us to the solution which is the most advantageous one for the national economy. It would not be appropriate to continue to divide the operational surface of the annual curve into surface strips as shown in Figure 9; to arrive at new aspects it will be appropriate to divide the surface into three greatly differing areas (figure 10).

The first area corresponds, on the whole, to one third of the annual hours, i.e. T = 0 to 33.3 percent; the second part T = 33.3 to 66.6 percent, and the third part T = 66.6 to 100 percent. They are the areas with peak, average and basic loads whose marginal ordinates cross the annual curve at important points.

The abscissas running through these points cut out the values of the peak, average and basic loads defining the corresponding annual operational ranges. Their values can be found the graphical way. However, it will be appropriate to give them in an analytical manner because they are simple to find as linear functions of the load factor.

The load factor is

$$m = \frac{P_{average}}{P_{max}} = \frac{A_a}{P_{max} \times T_a} = \frac{T_m}{T_a} .$$

1. Relative figures of the annual maximum factors:

$$\frac{P_{Spitze}}{P_{max}} = 1 - m - \frac{1-m}{6} = \frac{5}{6}(1-m)$$

$$\frac{P_{Mittellast}}{P_{max}} = 2\,\frac{1-m}{6} = \frac{1-m}{3}$$

$$\frac{P_{Grund}}{P_{max}} = m - \frac{1-m}{6}$$

Spitze - Peak Mittellast - Average Load Grund -Basic

2. Relative figures of the annual production factors:

$$\frac{A_{Spitze}}{A_a} = \frac{\frac{5}{6}(1-m)\,P_{max}\cdot\frac{1}{9}T_a}{m\cdot P_{max}\cdot T_a} = \frac{5}{54}\,\frac{1-m}{m}$$

$$\frac{A_{Mittellast}}{A_a} = \frac{\frac{1-m}{3}\,P_{max}\cdot\frac{1}{2}T_a}{m\cdot P_{max}\cdot T_a} = \frac{1-m}{6\,m}$$

$$\frac{A_{Grund}}{A_a} = \frac{\left(m - \frac{1-m}{6}\right)P_{max}\cdot T_a}{m\cdot P_{max}\cdot T_a} - \frac{5}{54}\,\frac{1-m}{m}$$

$$= 1 - \frac{14}{54}\,\frac{1-m}{m}$$

3. Relative figures of the factor of duration of consumption = load factor of annual maximum load factor:

$$\frac{T_{m\,Spitze}}{T_a} = \frac{A_{Spitze}}{P_{Spitze}\cdot T_a} = \frac{P_{m\,Spitze}}{P_{Spitze}} = m_{Spitze} = \frac{1}{9}$$

$$\frac{T_{m\,Mittellast}}{T_a} = \frac{A_{Mittellast}}{P_{Mittellast}\cdot T_a} = \frac{P_{m\,Mittellast}}{P_{Mittellast}} = m_{Mittellast} = \frac{1}{2}$$

$$\frac{T_{m\,Grund}}{T_a} = \frac{A_{Grund}}{P_{Grund}\cdot T_a} = \frac{P_{m\,Grund}}{P_{Grund}} = m_{Grund}$$

$$= \frac{1 - \frac{14}{54}\,\frac{1-m}{m}}{m - \frac{1-m}{6}}\,m$$

(Only the last equation is apparently less simple than the other equations; however, its numerator and nominator are available from previous equations.)

It is intended to give the relative figures of the annual curves of 1958 and 1965 as an example.

1. 1958 (Figure 11) m = 72.9 percent.

$$\frac{P_{Spitze}}{P_{max}} = \frac{5}{6}(1 - 0{,}729) = 22{,}6\%$$

$$\frac{P_{Mittellast}}{P_{max}} = \frac{1 - 0{,}729}{3} = 9{,}0\%$$

$$\frac{P_{Grund}}{P_{max}} = 0{,}729 - \frac{1 - 0{,}729}{6} = 68{,}4\%$$

$$\frac{A_{Spitze}}{A_a} = \frac{5}{54}\,\frac{1 - 0{,}729}{0{,}729} = 3{,}4\%$$

$$\frac{A_{Mittellast}}{A_a} = \frac{1 - 0{,}729}{6 \cdot 0{,}729} = 6{,}2\%$$

$$\frac{A_{Grund}}{A_a} = 1 - \frac{14}{54}\,\frac{1 - 0{,}729}{0{,}729} = 90{,}4\%$$

$$m_{Spitze} = \frac{T_{m\,Spitze}}{T_a} = \frac{1}{9} = 11{,}1\%$$

$$m_{Mittellast} = \frac{T_{m\,Mittellast}}{T_a} = \frac{1}{2} = 50{,}0\%$$

$$m_{Grund} = \frac{T_{m\,Grund}}{T_a} = \frac{0{,}904}{0{,}684}\,0{,}729 = 96{,}3\%$$

2. 1965 (Figure 12) m = 65.1 percent.

$$\frac{P_{Spitze}}{P_{max}} = \frac{5}{6}(1 - 0{,}651) = 29{,}1\%$$

$$\frac{P_{Mittellast}}{P_{max}} = \frac{1 - 0{,}651}{3} = 11{,}6\%$$

$$\frac{P_{Grund}}{P_{max}} = 0{,}651 - \frac{1 - 0{,}651}{6} = 59{,}3\%$$

$$\frac{A_{Spitze}}{A_a} = \frac{5}{54}\,\frac{1 - 0{,}651}{0{,}651} = 5{,}0\%$$

$$\frac{A_{Mittellast}}{A_a} = \frac{1 - 0{,}651}{6 \cdot 0{,}651} = 8{,}9\%$$

$$\frac{A_{Grund}}{A_a} = 1 - \frac{14}{54}\,\frac{1 - 0{,}651}{0{,}651} = 86{,}1\%$$

$$m_{Spitze} = \frac{T_{m\,Spitze}}{T_a} = \frac{1}{9} = 11{,}1\%$$

$$m_{\text{Mittellast}} = \frac{T_{m\,\text{Mittellast}}}{T_a} = \frac{1}{2} = 50{,}0\%$$

$$m_{\text{Grund}} = \frac{T_{m\,\text{Grund}}}{T_a} = \frac{0{,}861}{0{,}593}\,0{,}651 = 94{,}5\% .$$

It can be seen that the peak load factor increases from 22.6 percent of the annual maximum load in 1958 to 29.1 percent in 1965. The basic load factor, on the other hand, decreases from 68.4 to 59.3 percent.

The peak load factor is only 3.4 percent of the annual procuction in 1958. In 1965 this value increases to 5.0 percent. On the other hand, the basic factor is 90.4 percent in 1958 and 86.1 percent in 1965. The proportion of mean consumption duration of the peak load to the annual duration and the load factor of the peak load factor respectively, is 11.1 percent of the basic load factor, in 1958 96.3 percent and in 1965 94.5 percent.

With these equations it is possible, if the load factor m is known, to find the various load indices. They are realistic in an approximate manner providing valuable data for long-term planning in regard to the values to be expected. On the other hand, conclusions may be drawn from these load indices in regard to the technical design of the power plants.

In regard to the result of the analysis the solution which is the most advantageous one for the national economy, must specialize the power stations for clearly defined responsibilities; this would deviate from the practice of the past, when they were prepared for all kinds of load cases(1). This means that for the consideration of basic, average and peak loads, separate power stations must be established. The latter can then be equipped with optimal capacity for their specific responsibilities of technical and economic nature.

The basic load must be absorbed by special basic power stations whose maximum efficiency degree is not designed for the load factor of the annual maximum but for the basic load factor only. In the case of 1965 94.5 percent must be taken as a basis and not m = 65.1 percent.

It is clear that the corresponding load factors for the average load factor with m = 50 percent and the peak load factor with m = 11.1 percent necessitate completely different technical responsibilities. It is absolutely appropriate to establish special plants for these types of loads which must also greatly deviate from each other in regard to investment indices. This means that, for example, low load factors must

be coupled with low investment indices.

Condensation power stations can be transformed to basic load stations; with coal heating it would be appropriate to erect them near coal pits. As far as we know, up to the present, atomic power stations must be included in this. Industrial power stations supplying heat which operate for a static level of consumption, belong to the basic power stations only in regard to their counterpressure operations.

The public heating and industrial power stations belong to the average load stations. The variable loads have a determining effect on the design of the boilersand turbines where the most important aspect is no longer the best efficiency but the capacity to adapt to changed loads.

In the analysis the peak load power stations must be considered vital points. The peak load factor of 29.1 percent in 1965 is a load of approximately $0.291 \times 11{,}100 = 3{,}230$ (MW). It cannot be justified to use powerstations for this load or to build such plants which are erected with the usual investment indices and then charged with $m = 11.1$ percent.

The investment index of the pump-fed power stations depends on local conditions. It may be commensurate for big steam power plants but also be more favorable. At present storage efficiency is approximately 65.0 percent; this is a fuel loss of 35 percent. Natural conditions in the GDR do not permit at all that fast increasing peak loads are outbalanced in the power balance with pump-fed storage capacities alone. Moreover, the geographical situation of the possible pump-fed stations does not always coincide with the center of requirements so that transformer stations with a low load factor are also needed. Particular attention must be given to the fact that the peak load problem in the GDR, on the whole, is not concerned with daily fluctuations but with seasonal load fluctuations; on the other hand, pumpstorage plants serve the daily equalization.

Much more important is the increasing possibility of using gas turbines to absorb peak loads. Usually, their index is lower than that of the pump-fed stations. They can be set up at the load center. Transformers are not necessary. The exhaust-heat of the gas turbines can also be made useful.

Condensation machines have particularly low investment figures when they are put up at power stations to absorb peak loads, as far as these stations serve the heat supply. As it is known, the investment figure of the additional condensa-

tion units set up, is only approximately 0.10 to 0.15 million deutsche mark/MW, on the basis of an existing counter-pressure plant.

The machinery may be designed as exhaust or bleeder turbines, in some cases also as simple condensation units. They make it possible to fully utilize existing capacity at all times; they are very important for the absorption of peak loads and the adjustability of power supply and the operational safety of the station.

The fuel consumption of the power station does not increase to an insignificant extent because the condensation unit, seen separately, operates with a low load factor. Then the overall load factor of the power station moves from the basic to the average load range.

To expand transformer plants to an extent which is justifiable in terms of the national economy, the location for all power stations must, in principle, be as near to the need areas as possible. However, a deviation from this principle is required in the interest of a favorable supply with fuel such as oil and water.

The big basic load stations heated with coal and operating on condensation basis, must be located in the vicinity of coal pits (orharbors). In the case of atomic energy this aspect is irrelevant. In the present stage of research it cannot be said to what extent the power stations should be in the vicinity of the center of need,in connection with the protection against radiation.

In principle, the heat supplying stations must be near the center of heat requirements (2). Frequently, the center of electric power requirements coincides with it so that the peak capacity of these power stations can be utilized in a particularly economical manner.

If the center of need is distant, transformer stations are required. In the first place and in principle, the latter must be erected for absorbing basic loads. The tendency must be to meet peak loads from local resources so that investments for extending the combined system can be kept as low as possibl

Summary

The analysis was made on the basis of the annual curve of the total requirements of the GDR in regard to electric power, particularly with the aid of the load factor from which all other indices can be deduced. The covered tendency of development of the load factor makes it possible for us to arrive at the necessary conclusions for long-term planning of power plants (3).

In conclusion it may be said that a socialist organization of the previously divided electric power economy has opened up new aspects for the technical policy of the power plants in regard to rationalization. These new aspects refer to the specialization of power capacities, in accordance with the load structure, for a separate absorption of basic, average and peak loads. The selection of the location for specialized production plants results from the necessity of minimum investment for transformer stations.

1130